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ABSTRACT

This manual is a source of learning activities and instructional materials for teaching environmental education concepts in grades 7-12. Contents are organized into the areas of consumer education, English language arts, home economics, mathematics, science and social studies, and are subdivided by suggested grade level or subject area where applicable. Supplementary activities are included. An appendix containing reference books and articles, periodicals, films and multimedia materials concludes this manual. (BT)

Living within our means:

energy and scarcity

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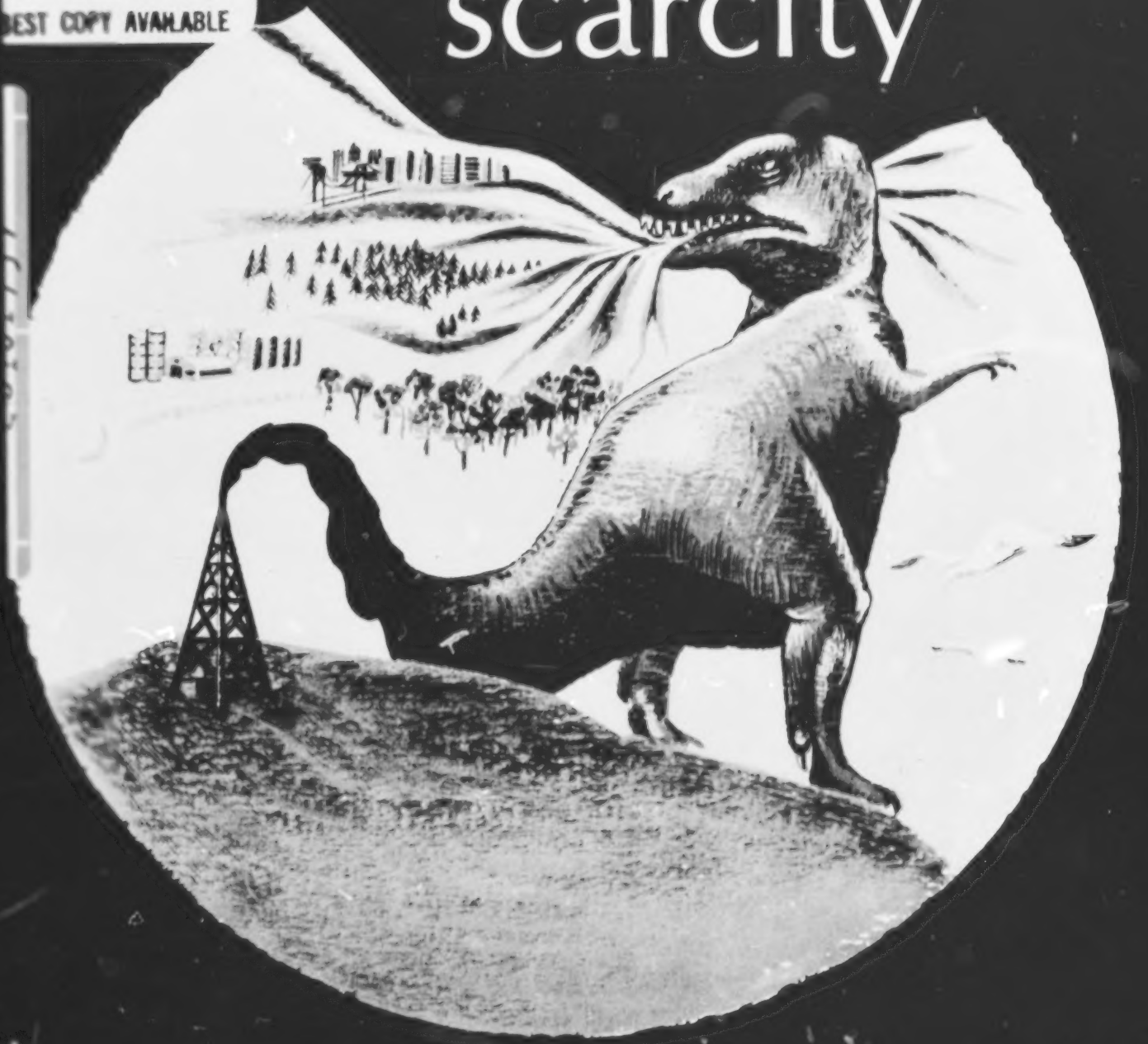

Environmental Education
Instructional Activities
7-12

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Foreword

Will the energy emergency and other related crises and shortages prove to be boon or bane for environmentalists and environmentally concerned citizens? Will society see some of the current conflicts between prevailing priorities and environmental limitations as a warning signal or merely as an economic problem requiring solution? Never before have these issues been so prominent in the public consciousness.

This publication, *Living Within Our Means: Energy and Scarcity*, has been prompted both by the currency of these issues and by the Department's continuing responsibility to provide instructional materials which will enhance our understanding of the all-pervasive nature of environmental considerations. This responsibility began with the release of *Isn't It Time We Learned* and the Regents' Position Paper No. 10, *Environmental Education*. The former was designed to alert school personnel to the problems posed by society's apparent disregard or disrespect for its natural surroundings and the scope of the school community's responsibility for addressing these problems. The Position Paper described the Department's responsibilities and objectives for environmental education.

Environmental Education Instructional Activities, K-6 and *7-12* were compendia of classroom exercises which supported numerous basic environmental understandings and concepts. The booklets were designed as supplements which would aid teachers in creating an environmental awareness and conscience among their students when appropriate to their regular subject matter objectives.

The *Handbook of Environmental Education Strategies* suggested ways in which teachers could use conventional instructional strategies in a manner that would support environmental education objectives. More importantly though, a major purpose of this bulletin was to illustrate the relationship of environmental concepts and understandings to the specific objectives and understandings of the various subject matter syllabuses.

Living Within Our Means: Energy and Scarcity develops that relationship to useful proportions by providing environmental activities which are keyed both to broad environmental understandings and to most of the disciplines at all grade levels. Within are provided enough activities for each grade and subject area to define and illustrate the place of environmental education in these areas of the curriculum.

Barry W. Jamason has planned and developed all of these environmental education publications.

VIVIENNE N. ANDERSON
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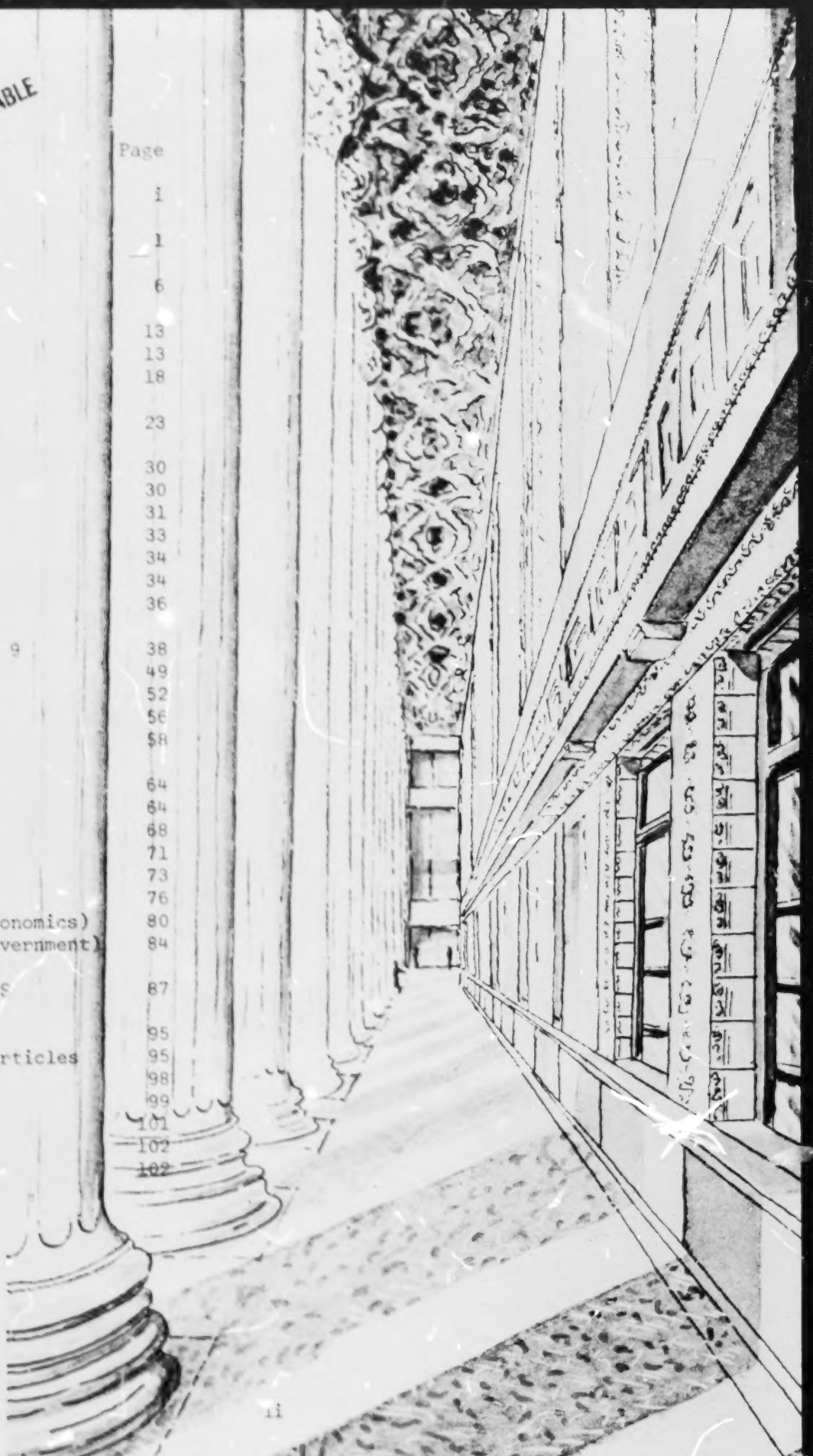

Introduction

RATIONALE

The purpose of this instructional manual is twofold. First, the urgency of the current spate of shortages, dominated by a shortfall of petroleum supplies and the concomitant energy emergency, needs to be examined reasonably and logically within the instructional program. These problems should be viewed as symptoms of a basic shortsightedness which characterizes our treatment of our natural surroundings and, as such, must be attended to in the educational process.

Second, the publication illustrates the most appropriate and efficacious manner in which environmental concerns may be integrated into classroom instruction. Thus, the environmental education activities herein are grouped in accordance with their relationship to the subject matter of the various disciplines. These relationships are reinforced by references to the pertinent skill, objective, or understanding in the subject matter curriculum bulletins. In this way, the syllabus references justify the placement of the environmental activities within the regular instructional framework.

As with the previous environmental education activity manuals, the understandings are suppositions about the relationship of man and his environment which have serious implications for the manner in which we should live. Ideally, pupil participation in the activity will enhance understanding of these suppositions and the questions should serve as guides to the direction or objective of the activity. The curriculum bulletin references indicate how regular instructional objectives are served at the same time.

DEVELOPMENT

A practical way to proceed in using this manual would be to review cursorily the activities provided for your subject area and grade level.† Then, refer to the syllabus understandings (or objectives, or skills) indicated as appropriate to the activities and determine at what point in your instructional program you will be dealing with these subject understandings. Thus, when that point is reached, you will have ready-made activities which will enhance both your subject matter understandings

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† Where activities are grouped by 7-9 or 10-12 rather than by individual grade levels, you will have to judge at which level use of the activity will be most appropriate. The complexity, skill expectation, and conceptual sophistication of the activity will help you make this determination. Then too, with minor modifications, many activities can be adapted for use at several grade levels.

In the English Language Arts section, asterisks (*) are used to indicate that the identified phrase in the activity instructions is the applicable learning objective in the syllabus reference found at the end of the activity.

and environmental education understandings. On the other hand, if the understandings for your subject area and grade level do not require sequential treatment, you may wish to choose activities in a more random fashion.

Because of the considerable emphasis on resource use throughout the activities in this booklet, it is strongly suggested that, at some early stage the instructor undertake a discussion activity centering upon the meaning of, and distinction between, *renewable* and *nonrenewable* resources. The understandings below, specifically the first, second, seventh, and tenth on page 2, the fourth on page 3, and the ninth on page 4 should be helpful in initiating such a discussion.

ENVIRONMENTAL UNDERSTANDINGS

The environmental understandings used as references for the activities and as a general group of learning expectations for the publication are provided below with a page index for the activities with which each is used.

Plants and animal populations are renewable resources. [34]

> The renewable resource base can be extended by reproduction, growth, management, and recycling. [23, 41, 44, 54, 56, 58]

Natural resources are interdependent and the use or misuse of one will affect others. [32, 40, 43, 53, 54, 78]

> Any one of an environment's components, such as space, water, air, food, or energy, may become a limiting factor. [13, 32, 34, 52]

Individuals should become well-informed about the best ways to manage and conserve our energy supplies. [10, 25, 28, 31, 36, 38, 55, 58, 60, 62, 65, 77]

> The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies. [8, 25, 31, 78, 91, 94]

Most resources are vulnerable to depletion in quantity and quality. [13, 23, 32, 91]

> Choices between essential needs and nonessential desires are often in conflict. [6, 7, 10, 15, 23, 25, 33, 59, 62, 65, 69, 91]

Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value. [36, 47, 60, 61, 66, 91]

> The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures. [15, 26, 34, 41, 44, 49, 61, 87]

Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.	[15, 26, 30, 52, 53, 78]
The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.	[7, 24, 64, 69, 71]
The waste of natural resources can limit the options available to future generations.	[10, 13, 46, 69, 73]
Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.	[38, 40, 43, 44, 47, 48, 54, 56, 58, 59, 61, 65 66, 68]
The material welfare and aspirations of a culture largely determine the use and management of natural resources.	[33, 66, 69, 75, 84]
Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits.	[14, 32, 64, 84, 93]
Water is a reusable and transient resource, but the usable quantity may be reduced by impaired quality.	[20]
Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.	[6, 24, 27, 70, 80, 83 92]
Energy is initially supplied to an ecosystem by the activities of green plants.	[23, 55]
Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.	[6, 70, 71, 73, 80]
Ethically, we are stewards rather than owners of the resource base.	[18, 19]
Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.	[7, 8, 16, 39, 50, 57, 70, 73, 76, 83, 90]
Earth's resources and recycling system can support only a limited number of people; therefore as populations increase and as resource supplies decrease, the freedom of the individual to use the resources as he wishes diminishes.	[27, 35, 52, 87]

The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.	[19, 20, 27, 30, 35, 46 - 87, 93]
Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency.	[71, 75, 83, 90]
Social, economic, and technological changes affect the interrelationships, quality, availability, and the use of natural resources.	[8, 28, 30, 43, 64, 68, 73]
Man must develop the technological and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.	[14, 30, 39, 77, 82, 93]
In a democracy, people must consent to, or insist upon, restrictions on resource allocation and use.	[14, 76, 84, 93, 94]
The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.	[40, 43, 50, 73, 82, 84]
As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.	[16, 18, 19, 20, 58, 68, 75]
Living things are interdependent with one another and with their environment.	[18, 19, 53]
Soil, trees, and water are classified as renewable resources, but, because their renewal or revitalization requires a major investment in time and effort, they may be more realistically considered depletable resources.	[23, 50]
As population expands and becomes more mobile, man's demands for natural resources increase.	[77, 78, 87, 92]
The Earth's main source of energy is the sun.	[38, 48, 59]

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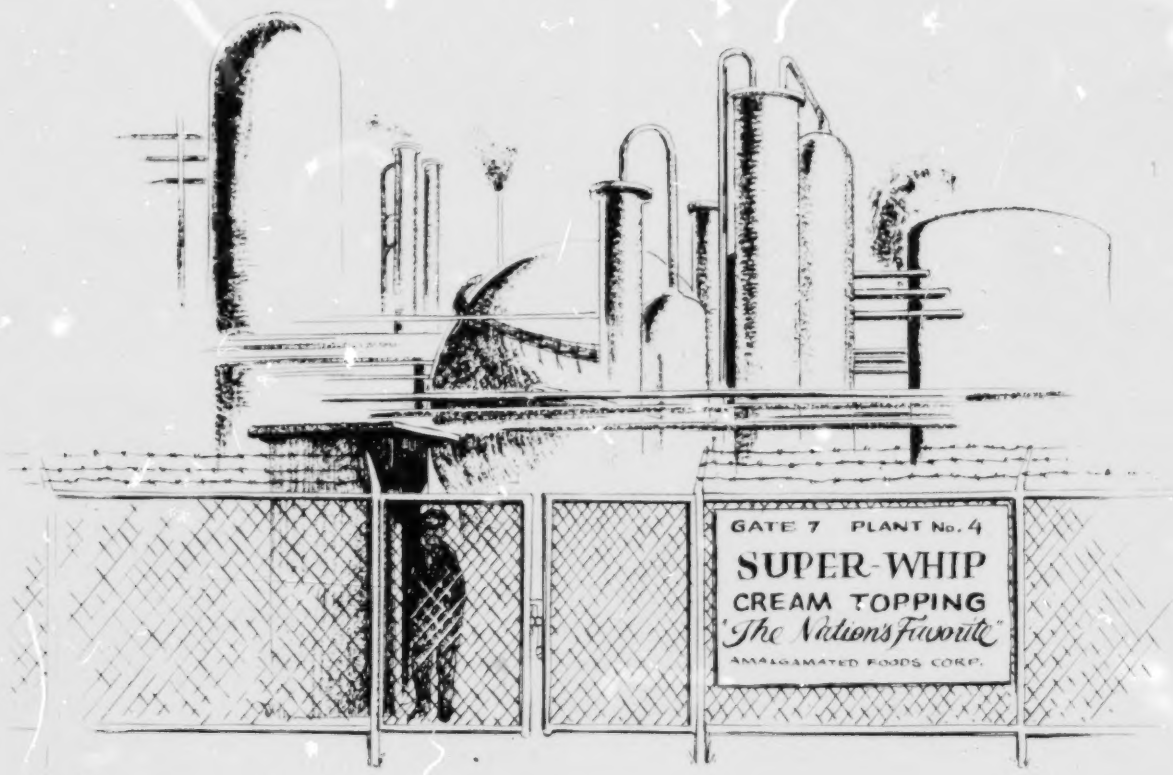

CONSUMER EDUCATION

The activities that follow are referenced to the Units and, within them, the Suggested Learnings as developed in the Department publication, Consumer Education... Materials for an Elective Course. In keeping with the objectives of that bulletin, the activities are nongraded and thus may be considered as an environmental supplement to consumer education. Special attention should be directed to Coping With the Problems of a Technological Age, Part I and Part II, which constitute a module in the series, *Expanded Programs of Consumer Education.* The understandings and activities in those two booklets offer the instructor further opportunity and direction for dealing with the problems of energy, resources, scarcity, and pollution.

Activity 1 - Almost half the population of the United States is under 21 years of age. As consumers, many of these young people are likely to exercise poor judgment in purchasing due to a lack of experience in the marketplace. Frequently, this faulty judgment is caused by failure to discriminate between necessities and luxuries, and by the influence of advertising on the purchases made.

Have a class committee conduct a survey of the class to determine which common consumer goods they consider necessary (essentials, or needs) and which seem to be simply desirable (nonessentials, or wants).

- Are needs the same for all students? Why? Can the members of the class agree on what is necessary? Why may this be difficult to do?
- Were there any students who considered some items essential while a majority of the class disagreed? If so, what were their reasons for these choices?
- Now that you have generally agreed upon a list of essentials, consider the list as though you were a young consumer in a developing nation such as India or Nigeria. Would any of the essentials now be considered nonessential? Why?
- If people in developing nations were to define essential and nonessential the way we do in America (and had the wherewithal to pursue these desires in the marketplace), what would be the effect on world resources?
- Name several nonessential consumer items you anticipate you will purchase during the next 12 months. How would your life be changed if you didn't buy them?

(*Environmental Understandings:* [Choices between essential needs and nonessential desires are often in conflict.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.] [Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.])

(*Syllabus References:* Consumer Education; *General Principles of Consumer Purchasing,* What Makes Us Buy Goods?, pp. 6-7)

Activity 2 - Have the class develop a list of ways that producers, through advertising, attempt to convince consumers that nonessentials are indispensable to you. The list should be supported by newspaper and magazine clippings. If it is possible to arrange, a brief, taped segment of a particularly "compelling" radio or TV commercial would be an informative highlight of this class project.

- Give examples of how you have been swayed by the power of advertising.
- Did you realize that you very often advertise products for a retailer or a manufacturer? Some examples of this are: labels in clothing, shopping bags that you carry away from the store, or a dealer's name permanently affixed to the automobile you buy. Now can you think of other examples?
- Should manufacturers and retailers get this type of free advertising? Can you do anything about it if you object?
- Make a list of some of our scarce resources which are further diminished by successful advertising campaigns for more modern products, greater "convenience" in packaging, and other "technological innovations."
- Suggest ways in which the power of the advertising industry might act more constructively in terms of our resource and energy problems. Is it likely that they will change their approach? Explain.

(*Environmental Understandings:* [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

(*Syllabus References:* Consumer Education; *General Principles of Consumer Purchasing,* Our Demand For Goods Is Stimulated By:, pp. 7-11)

Activity 3 - Consumption is continually being increased and a large part of the increase is a result of the producer's ability to create wants. This expansion of production in turn increases the rate of resource use. In connection with this stimulation of artificial "need," have the students categorize products by the following types of advertising appeals:

-emotional
-logical
-creative (humorous, artistic)

-testimonial
-psychological

- Identify explicitly each commercial or advertisement to which you refer.

- Show how business has created needs in areas where no need existed 25 years ago... 50 years ago... 75 years ago.

- Use economic statistics to show actual growth in the areas selected for the question above.

- Did the areas of growth you chose as examples represent the use of renewable or nonrenewable resources? Explain.

(*Environmental Understandings:* [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [Choices between essential needs and nonessential desires are often in conflict.])

(*Syllabus References:* Consumer Education; *General Principles of Consumer Purchasing*, Our Demand For Goods Is Stimulated By:, pp. 7-11)

Activity 4 - Individuals tend to consider convenience rather than economy and the environment when purchasing food, clothing, and appliances. With planning, a wise shopper can save money and lessen the demand for those products which: (1) consume disproportionate amounts of resources and energy, (2) are actually superfluous to our needs for a comfortable life, and (3) cause disposal problems. Have members of the class conduct the following experiments or consumer exercises.

-Plan a complete dinner. Purchase as many items as will make preparation of the meal as quick and easy as possible. One group should record the cost of the TV dinner, the frozen cream pie, etc. Now, for comparison, purchase chicken, vegetables, potatoes, and dessert which are in their natural or basic form.

- Which meal was cheaper to prepare? Compare the actual costs.

- Did the convenience meal use less human and electrical (or natural gas) energy?

- Did the extra time involved in preparing the meal with basic ingredients prevent you from doing better things with your time? How important a factor is this?

-Record in itemized fashion the expenditures your family makes for beverages for a month. Then, using this log, see if there were times when the beverages (milk, soda, beer, coffee, tea, juice) could have been purchased in bulk (quart vs. pint; half-gallon vs. quart; gallon vs. half-gallon; case vs. six-pack or individual bottles).

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- Could you just as easily buy larger containers to save money and reduce demand for packaging materials?

- Were returnable containers available? How does the price of the beverage (less the deposit which is returned to you) compare with identical product and container size when sold in non-returnable fashion?

- Is it worth the savings and the effort to buy returnables when possible? Would we be making a positive contribution in terms of the environment, resources, and energy use? Explain.

-List numerous small electrical appliances commonly used in the home. Make a table showing the cost to purchase, and the cost to operate such appliances. Then consider whether or not some human-powered device might be used as a substitute without noticeable hardship. In many instances, a consumer would save most of the purchase price of the appliance and all of the cost (though negligible for most of these devices) of energy to operate it. The table on page 39 will permit you to approximate operating costs of some items and the public utility company can provide additional information. Refer to the example below.

In general the more refined the product the greater the "energy" costs are; in other words, as we demand products requiring a higher degree of technology to produce we pay not only in additional purchasing dollars but also in terms of the greater consumption of scarce, energy resources.

Appliance	Purchase Price	Annual Cost To Operate	Total	Total Cost Of Substitute
electric carving knife	$12.95			$3.00
percolator	$15.95	$2.36		$2.95 (pyrex percolator)
electric can opener	$ 7.00			$ .39

(To calculate operating cost yourself, convert the wattage of the appliance to kilowatts, e.g. 1200 watts = 1.2 kilowatts, and multiply by the number of hours of use annually. This kilowatt-hour figure is then multiplied by the prevailing rate per kilowatt-hour.)

- Do you find that you can dispense with certain nonessentials without undue hardship? Explain.

- Explain how the information you tabulated provides some incentive for reconsidering some of your consumer practices.

- Describe how such consideration, on a wide scale by many people, can ease our demand for resources and slow our increasing rate of energy use.

- Are the ideas of consumer economy and environmental awareness compatible? Complementary? Explain.

(*Environmental Understandings:* [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.] [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.] [Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources.])

(*Syllabus References:* Consumer Education; *Purchasing Food, Clothing, Furniture, and Appliances,* Why Does Managing the Food Budget Require Knowledge and Skill?, p. 37; What Are Some Wise Habits For Food Shoppers?, pp. 39-40; What Are Some Wise Habits in Buying Appliances?, p. 45)

Activity 5 - People should carefully distinguish between transportation needs and transportation desires when they purchase automobiles, since both economic and environmental considerations are involved. Involve the class in a automobile comparative shopping survey by way of having students learn to consider all the significant factors that such a potential expenditure represents. Have students select a luxury, a standard, an intermediate, a compact, and a subcompact from each of the four United States manufacturers, and include one manufacturer who exports to this country. Compare each model (25 in all) for base price, options, maintenance requirements, frequency of repair records, gas consumption, and resale value. The information can be obtained from dealers, consumer and auto magazines, and the Blue Book (for resale value).

- People often buy what others want or what others want them to buy. Do you agree or disagree with that statement? Justify your answer.

- Discuss the relationship between each of the following pairs of factors:

  -size and cost
  -size and gas consumption
  -options and gas consumption
  -frequency of repair and options
  -cost of maintenance and size

- Are autos, whichever type one purchases, used efficiently? Explain, considering the efficacy of car pools and improved public transportation in light of the recent oil shortage.

- Do dealers' statements on performance differ from test results as reported by consumer and trade magazines? Give details.

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- What factors will be most important in helping you decide which car to buy?

- Can we continue to justify the production of 10 million autos a year? Explain.

- What environmental problems are created by the automobile? Which can be solved by diligent effort, and which may never be remedied?

(*Environmental Understandings:* [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [Choices between essential needs and nonessential desires are often in conflict.] [The waste of natural resources can limit the options available to future generations.])

(*Syllabus References:* Consumer Education; *Purchasing And Maintaining An Automobile*, pp. 47-64)

ENGLISH LANGUAGE ARTS

Grades 7-9

Activity 1 - Instruct members of the class to develop a brief synopsis of each science fiction film or television program they see (Listen for the Main Idea; Listen for and Evaluate Supporting Material)* over a period of 6 to 8 weeks. The prerequisite characteristic of the program or movie plot is that it addresses the problems which arise when any environmental component such as space, water, air, food, or energy becomes a limiting factor (e.g., spaceship explorations which seek alternatives to earth's increasing population density; survival in a situation of abnormal food or water supply shortages; radioactivity in the atmosphere).

Discuss these films and programs to determine the main idea and purpose the author had in writing the story; list the sub ideas and how they relate to the main idea. (Recognize the Importance of Reporting Accurately; Recognize and Utilize the Various Forms of Speaking)* Students should compare and contrast their own ideas of the future of this planet and its potential problems with the author's projections. Students should then vote on which was the best science fiction presentation and why, listing the reasons for their choice on the chalkboard.

- In the past, have the predictions or prophecies of science fiction writers proven to have some validity? Give some specific examples.

- Describe some real-life, modern-day situations which reflect shortages of or threats to environmental components which suggest difficulties for the future.

- Consider the energy shortage and our present concern with finding alternate sources of energy to compensate for dwindling reserves of petroleum. Find a parallel in a science fiction plot which describes how man's resourcefulness and ingenuity permitted him to surmount a similar, major limiting factor.

- Are science fiction writers in any way offering "solutions" or encouraging foresight and planning, or are they merely indulging in flights of fancy using the problems of the real world as a point of departure? Explain your answer and include reference to a specific science fiction tale which supports it.

(*Environmental Understandings:* [Any one of an environment's components, such as space, water, air, food, or energy, may become a limiting factor.] [Most resources are vulnerable to depletion in quantity and quality.] [The waste of natural resources can limit the options available to future generations.])

(*Syllabus References:* English Language Arts: Listening and Speaking K-12; *Aural Comprehension 7-12*, pp. 11-22; *Participation in Speaking 7-12*, pp. 69-77)

Activity 2 - Select a committee of four or five students and ask that they write a combined physical, social, economic, and occupational description of a fictitious community, similar to their own. The description should include the natural environment within which the community is located and several conditions or problems which threaten elements of the natural environment and thus, in turn, threaten the human community itself. The committee should then edit this report (with your assistance) and duplicate it for all members of the class.

After the students have read the ditto sheet, inform them that they are to engage in a role-playing activity. They are to make a list of the representative types of roles for people in the community and then each student should select a role he would like to assume. The list of representative roles might be something like this:

-housewife
-mother
-real estate agent
-land owner
-bank president
-secretary
-high school student
-construction worker
-immigrant
-politician (local)
-store-owner
-homeowner
-apartment dweller

The objective is to have this cross-section of citizens come together to solve a common, community environmental problem. Some student activities and procedures which will be necessary in trying to achieve this objective will be the following:

-bring neighbors and others to your point of view (Understand the Importance of Listening)*
-discuss the problem and try to find areas of agreement with them in numerous contexts, as determined by roles in the community (Recognize and Utilize the Various Forms of Speaking)*
-unite with those who agree with you to influence the majority
-publicize your concern through the media, a town meeting, and petitions (Recognize the Importance of Reporting Accurately)*
-produce information about other communities which have faced or resolved similar issues (Utilize Patterns of Organization; Use Various Supporting Materials)*

- How can individual citizens bring about change in the community?
- Are your community's problems serious enough to warrant the long, patient striving for solution necessary in such a process?
- Who will solve these problems if none of those whose roles were acted out will?
- Are the issues facing your community the same as those facing the nation and the world? Describe the similarities and/or differences.

(*Environmental Understandings:* [In a democracy, people must consent to, or insist upon, restrictions on resource allocation and use.] [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.] [Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits.])

(*Syllabus References:* English Language Arts: Listening and Speaking K-12; *Aural Comprehension 7-12*, pp. 11-22; *Participation in Listening K-12*, pp. 31-38; *Participation in Speaking K-12*, pp. 69-77; *Content in Speaking 7-12*, pp. 107-116)*

Activity 3 - The actuality of the automobile's emergence as the dominant, nonetheless questionable, form of transportation provides an opportunity to develop composition skills among the students. Using the activity on the bottom of page 68 in the syllabus (English Language Arts: Composition Section 7-12), let students refresh their memories about the development of the automobile while they discover the effectiveness of comparison and contrast in developing an idea (Organize by Comparison and Contrast)*. On the chalkboard, they may construct a chart which details the increased social, economic, and environmental impact of the automobile if they compare its characteristics Then (ca. 1905) and Now (1974). Have the students add as many items as possible to the comparisons provided (e.g., resource consumption; air pollution; cost in proportion to income). Once the chart is completed have them write paragraphs summarizing a pair, or pairs, of comparisons.

- Explain whether or not the automobile still "earns its keep" in terms of its contributions and in light of its disadvantages.
- How do we arrive at the conclusion that the auto is virtually a necessity?
- Is a significant proportion of the automobile-using public aware of the long range costs of automobile transportation? Are you? Explain.

The following are the headline and sub-headline of an article printed in the *New York Times* on January 27, 1974:

Car Buyers Putting Limits On Fuel-Economy Efforts

Few Switching From Larger to Smaller Models in One Step—Many Request the Gasoline-Consuming Extras

Have several of the students refer to the article, read it, and report the gist of the feature to the class.

- What effect has the energy crisis had upon the attitudes and actions of car buyers?

- Why are people cynical about the reality of a gasoline shortage?

Ask the students to react, verbally and then by writing a paragraph or brief composition, to the situation presented below:

> A man entered a Ford dealership in Detroit and indicated to the salesman that he wanted to get rid of his Lincoln Continental and purchase a smaller car. He examined, but decided against the compact Mustang II because he couldn't get all the options he wanted. He ended up buying an intermediate-sized Torino. Regarding the options, he told the salesman, "You name it and I'll get it." His new Torino has a vinyl roof, air-conditioning, power brakes and steering, rear window defroster, and whitewalls. The man's parting comment was, "I won't settle for less than I'm used to."

- Will others have to settle for less because this man and others like him won't?

(*Environmental Understandings:* [Choices between essential needs and nonessential desires are often in conflict.] [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.])

(*Syllabus References:* English Language Arts: Composition 7-12; *Composition Organization and Development 7-9*, pp. 62-72)*

Activity 4 - Assemble for class study a collection of man's efforts in several artistic media, using a central theme. (Recognize That the Author Creates Mood by the Choice of Words Having Appropriate Connotations, Sounds and Rhythms)* For example, with "trees" the theme, present the following:

-Paintings: "Edge of the Woods" (Roswell M. Shurtleff)
"Autumn Oaks" (George Inness)

-Poems: "Trees" (Joyce Kilmer)
"Stopping by Woods on a Snowy Evening" (Robert Frost)

-Songs: "Maple Leaf Forever" (Alexander Muir)
"Autumn Leaves" (Johnny Mercer)

Emphasize that man's appreciation of the environment reinforces his concern for it.

- Identify the authors of these efforts.
- Does examination of these creative efforts move you to a concern for the environment? Explain.
- What is the benefit of such creativity?
- Does this ability of man suggest that he is capable of protecting the environment he can depict so well? Explain.

Bring to the classroom nature pictures representing the four seasons. Using these as motivation, have the students use poetry to create a feeling of oneness with nature and its beauty. Suggest that students write about some small marvel of nature that impressed them at a particular time or season. Encourage them to illustrate their poems. (Recognize That Poetry Appears in the Form of Stanzas or Regular Divisions)*

- Can words really capture the beauty of nature? Explain.
- How is it possible for such poetic expression to inspire men to preserve and cherish that beauty?

Conduct a brief discussion about what man has done to his environment through deliberate destruction, apathy, and ignorance, and what he proposes to do in the future to correct his mistakes. Then, with the discussion as a background, conduct an essay contest on the topic, *What the Future Holds for Mankind's Environment.* Arrange for some kind of recognition for the winning essayist.

- What role does the written word play in the battle to protect man's environment?

(*Environmental Understandings:* [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

(*Syllabus References:* English Language Arts: Literature K-12; *Rhythm, Sound, and Stanza 7-9*, pp. 144-146; *Mood 7-9*, pp. 150-151)*

ENGLISH LANGUAGE ARTS

Grades 10-12

Activity 1 - Ask a small group of students to prepare speeches based upon the following quotations. Discuss with these students ways of structuring oral presentation to express complete thought. Remind them that the main purpose of the talk is to communicate the author's meaning, his particular point of view, and possible circumstances which prompted the quotation. (Express a Complete Thought Orally)*

-"All is change; all yields its place and goes."

Euripides

-"Value determines what we ought to do, not what one necessarily desires to do."

Dorothy Rethlingshafer

-"Man is the only animal that laughs and weeps, for he is the only animal that is struck with the difference between what things are and what things ought to be."

William Hazlitt

-"There is nothing man cannot make natural; there is nothing he cannot lose."

Blaise Pascal

-"We used to be individuals, not populations. Perhaps we are now preparing for the great slaughter. No reason to be alarmed; stone dead is dead; breeding like rabbits we hasten to meet the day."

Robinson Jeffers

-"No person who is not a great sculptor or painter can be an architect. If he is not a sculptor or painter, he can only be a builder."

John Ruskin

-"Far off noises of the world retreat, the loud vociferations of the street become an undistinguishable roar."

Henry Wadsworth Longfellow

-"All things to each other
by almighty power
hidden linked are
That thou cans't not touch
a flower
Without troubling of a star"

Francis Thompson

-"Behold the turtle; he makes progress only when he sticks his neck out."

James B. Conant

ENGLISH LANGUAGE ARTS

-"For as long as man has dwelt upon this earth spring has been the season of rebirth and the singing of the birds. Now in some parts of America spring has been strangely silent, for many of the birds are dead."

Rachel Carson

-"We travel together, passengers on a little spaceship, dependent on its vulnerable reserves of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work, and the love we give our fragile craft."

Adlai Stevenson

(*Environmental Understandings:* [Living things are interdependent with one another and with their environment.] [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.] [Ethically, we are stewards rather than owners of the resource base.])

(*Syllabus References:* English Language Arts: Listening and Speaking K-12; *Content in Speaking, p. 108*)*

Activity 2 - The instructor may wish to make a creative writing assignment in which the students are asked to select a quotation found in Activity 1 as a theme for the composition. Encourage the students to attempt figurative comparisons by using analogies and implementations in their comparisons. (Organize by Comparison and Contrast; Develop Tone)* Students should include in their writing: time and place, description of existing conditions, the authors' perceptions and values, and analogies of specific environmental conditions (today).

(*Environmental Understandings:* [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.] [Ethically, we are stewards rather than owners of the resource base.])

(*Syllabus References:* English Language Arts: Composition K-12; *Organization and Development,* pp. 78-81)*

Activity 3 - Discuss the way in which the purpose of a subject affects the form, style, and methods of support. Following the general discussion, designate six or eight students to serve on a panel. Have an equal number of students take each side of the issue raised in one of the quotations listed below. Repeat, using a different group of students for the second quotation or other quotations suggested by the class. (Types of Presentation)*

-"Too many cars, too many factories, too much detergent, too much pesticide, multiplying contrails, inadequate sewage treatment plants,

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too little water, too much carbon dioxide... all can be traced easily to too many people."

Paul Ehrlich

-"The chessboard is the world; the pieces are the phenomena of the universe; the rules of the game are what we call the laws of Nature. The player on the other side is hidden from us. We know that his play is always fair, just, and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance..."

Thomas Huxley

(*Environmental Understandings:* [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [Living things are interdependent with one another and with their environment.])

(*Syllabus References:* English Language Arts: Listening and Speaking K-12; *Recognize and Utilize the Various Forms of Speaking,* pp. 73-74)*

Activity 4 - Through discussion, lead the students to understand that the selection and arrangement of the causes determine the results. Then, make a composition assignment based on the following photographs, or others offered by the students, in which students are asked to show the relationship of cause and result.

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- What are some of the causes of the conditions illustrated?
- How are individuals affected by these conditions?
- What values and attitudes are developed by individuals as a result of these conditions? Why?
- How can these conditions be ameliorated by the individual? By society in general?

(*Environmental Understandings:* [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.] [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [Water is a reusable and transient resource, but the usable quantity may be reduced by impaired quality.])

(*Syllabus References:* English Language Arts: Composition K-12; *Organization and Development*, pp. 75-76)*

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HOME ECONOMICS

Grade 7

Activity 1 - Instruct the class to plan and prepare a bulletin board illustrating the nutrients essential to good health, supported by pictures or drawings of food items which supply them. The display should indicate the origin of these nutrients before, and as, they become constituents of food products. Invite a diet/nutrition specialist from a public agency to speak to the class on the subject represented by the bulletin board information.

- Why are good soil management practices of prime concern to the agriculture industry and to us as consumers?
- How can soils become contaminated, or less fertile, and what does this do to the supply of food and the cost of food?
- What are some of the specific health problems associated with nutrient deficiency?
- What is the effect of packaging and the addition of preservatives on the nutrient value of foods?
- Are the added costs of sophisticated packaging for the sake of convenience worth it to the consumer? Explain.

(*Environmental Understandings:* [Energy is initially supplied to an ecosystem by the activities of green plants.] [Soil, trees, and water are classified as renewable resources, but because their renewal or revitalization requires a major investment in time and effort, they may be more realistically considered depletable resources.])

(*Syllabus References:* Home Economics Education; *Home Economics Grade 7*, Concept II, A. Nutrition for Teen-Agers, Generalizations 3-4, p. 58)

Activity 2 - Several members of the class should list many of the processed and convenience food items on their next visit to the market. Using the result as a class checklist, have the entire class note which of the items are commonly purchased for use in their homes. Tabulate the results to determine the most-often used items. Determine which of the items could be prepared in the home using the basic ingredients. From these, select two or three which can be prepared as an experiment in comparative costs.

- Were the costs of preparing the food at home higher or lower than if purchased at the store? Explain.
- Did you consider the cost of using your gas range, or electricity, or water? If not, approximately how much would this add to the cost?

- Should the time spent preparing these foods (human energy) at home be considered in your comparison? Explain.
- Make a final list of the food items you have decided could be prepared more economically at home.
- What kinds of materials are used in processing and packaging the foods you have been discussing?
- Do any of these materials represent resources which must be husbanded?

Discuss the concept of recycling with the class, and further develop the preceding question by requiring students to list the resources and note which of them may, for practical purposes, be recycled.

- Why must we consider reusing much of what we have been discarding? (Give several reasons dealing with volume of waste, resource depletion, and thrift, among others.)
- Describe any recycling efforts which are already occurring in your community.

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [Most resources are vulnerable to depletion in quantity and quality.] [Choices between essential needs and nonessential desires are often in conflict.])

(*Syllabus References:* Home Economics Education; *Home Economics Grade 7*, Concept II, B. Participation in Family Meal Management, Generalizations 2-3, p. 59)

Grade 8

Activity 1 - Assign a group of students the task of listing the types of material which are used in "commonly" purchased wearing apparel. Consider:

-wool	-satin
-cotton	-orlon
-silk	-rayon
-lamé	-muslin
-voile	-nylon
-lace	-tolle
-denim	-dacron

They should divide the list into two categories, after first deleting the items which are combinations or variations of basic fibers or materials already on the list. These categories are *natural* and *manmade* (or artificial or synthetic). Have the group determine the source of the fabric (wool - sheep, cotton - plant, dacron - chemicals [petroleum], rayon - cellulose, [wood]).

- Using a wall map of the United States, pinpoint (a) the location of the raw materials involved, and (b) the sites where they are processed into finished products.

- To what extent is the United States self-sufficient in the raw materials involved?

- Which raw materials are imported? Which finished products made from these materials are imported?

- Why has the cost of wearing apparel risen so rapidly during the past few years?

- How should all of this information guide you when you make clothing purchases?

- What basic reasons do you rely upon to dictate when, where, and for how much you purchase clothing?

(*Environmental Understandings:* [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

(*Syllabus References:* Home Economics Education; *Home Economics Grade 8*, Concept II, B. Clothing Selection, C. Clothing Construction, pp. 64-66)

Home Economics 1 (Grade 9 or 10)

Activity 1 - The problem of scarcity is a factor in many of the decisions made in our lives. Family budgeting for the purchase of clothing encounters this factor in at least two ways; the relative scarcity of family financial resources considering the many needs, including clothing, which compete for them; the effect of scarcity upon the resources which are used in the manufacture of clothing.

Instruct the students to develop a pie graph showing the percent of family income (this will permit them to use actual dollar amounts in figuring this with their parents and substitute percentages in the interest of confidentiality) that should be allocated to each of the family's normal expenditures (housing [rent or mortgage payment, utilities, taxes, telephone], food, clothing, transportation, savings, medical, education, recreation, etc.).

- In what order did you estimate and assign these percentages?

- Was clothing about the third or fourth item to appear?

- Did you adjust the percentage for clothing more frequently than others in order to allow enough for food or rent, for example?

- How may savings be realized by making decisions about what is desirable versus what is necessary in terms of clothing needs?

- List several ways in which savings may be achieved in the purchase of clothing.

- What are the alternatives when we are forced to limit the family resources which may be spent on clothing, or when necessary items of wearing apparel are simply unavailable?

- How do the prices of clothing reflect the scarcity of resources such as labor, land, materials (natural and synthetic), fuel, and transportation? Use specific examples of clothing, materials, industries, and the like.

- Describe some changes you might imagine as occurring in the clothing industries due to a continuing or permanent scarcity of certain resources. How might this affect styles, purchasing habits, and the economy generally?

(*Environmental Understandings:* [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.] [Choices between essential needs and nonessential desires are often in conflict.])

(*Syllabus References:* Home Economics Education; *Home Economics 1*, Concept II, C. Clothing and Individual Growth, Generalizations 2-3, p. 74)

Homemaking 2 (Grade 10 or 11)

Activity 1 - An understanding of the nature and application of both human and nonhuman resources is essential to family management and to management as it pertains to society in general. Provide the class with the general lists of human and nonhuman resources as given in Generalization 2 on page 76 of the syllabus. Have them match each with personal or family functions or goals which utilizes each (e.g., knowledge - success in school; time/energy - father's job income; money - food shopping).

- How does the knowledge of the extent of your resources permit you to establish your goals? Give several specific examples.

- Which of the human and nonhuman resources can be increased? Which are limited or are impossible to expand? Why is this so?

- Describe the parallels which exist between the management of known family resources and the management of known societal and economic resources (e.g., coal, iron, copper, labor, capital, timber, and water).

- How can economic resources be increased?

- Does our society manage its resources well? Explain.

(*Environmental Understandings:* [Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.] [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.])

(*Syllabus References:* Home Economics Education; *Home Economics 2*, Concept I, A. The Role of Management in Personal and Family Living, Generalization 2, p. 76, B. The Management Process, Generalizations 1-3, pp. 76-77)

Home Economics 10 (Grade 11 or 12)

Activity 1 - Refer to Activity 1 on page 23. Emphasize the necessity of maintaining a nutritionally adequate diet. Have the students select a developing nation and construct a case study of the problem of nutritional deficiency prevalent in such a country.

- Explain how these nutritional deficiences relate to the generally unequal distribution of resources throughout the world.

- In what way does population size and the rate of population growth affect this imbalance of world resources?

- How does the shortage or prohibitive cost of petroleum products and phosphates affect the diets of people in developing countries?

- What is being done to solve the world's population and food problems?

(*Environmental Understandings:* [Earth's resources and recycling system can support only a limited number of people; therefore as populations increase and as resource supplies decrease, the freedom of the individual to use the resources as he wishes diminishes.] [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

(*Syllabus References:* Home Economics Education; *Home Economics 10*, Concept II, A. Planning Healthful Meals, Generalizations 1-2, pp. 132-133)

Activity 2 - Refer to Activity 2 on page 23.

(*Syllabus References:* Home Economics Education; *Home Economics 10*, Concept II, B. Buying Food and Food Products, Generalizations 1-2, pp. 133-134)

Home Economics 11 (Grade 11 or 12)

Activity 1 - Select a group of students to collect clothing labels, newspaper advertisements, and fashion magazine articles which provide information about the materials used in the manufacture of wearing apparel. A second group of students might then use this information in constructing an attractive and informative bulletin board display by showing common clothing items surrounded by the products and resources (natural and/or synthetic) used in their manufacture.

- Have you included design, labor, packaging, and transportation as inputs for each of the items? (These could be illustrated in a way that reveals they are generalizable to all of the items.)
- Which of the resources for each of these items are, or will soon be, in short supply?
- What will we do when the resource and thus the product is unavailable for this reason? Do we substitute a clothing item, or do we substitute for the resource? Explain and describe a real or hypothetical example.
- Which, if any, of the resources are of virtually unlimited availability?

(*Environmental Understandings:* [Social, economic, and technological changes affect the interrelationship, quality, availability, and use of natural resources.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.])

(*Syllabus References:* Home Economics Education; *Home Economics 11*, Concept II, B. Economic Aspects of Clothing Selection, Generalizations 1-2, pp. 140-141; Concept III, A. Construction and Use of Textiles, Generalizations 1-2, pp. 141-142)

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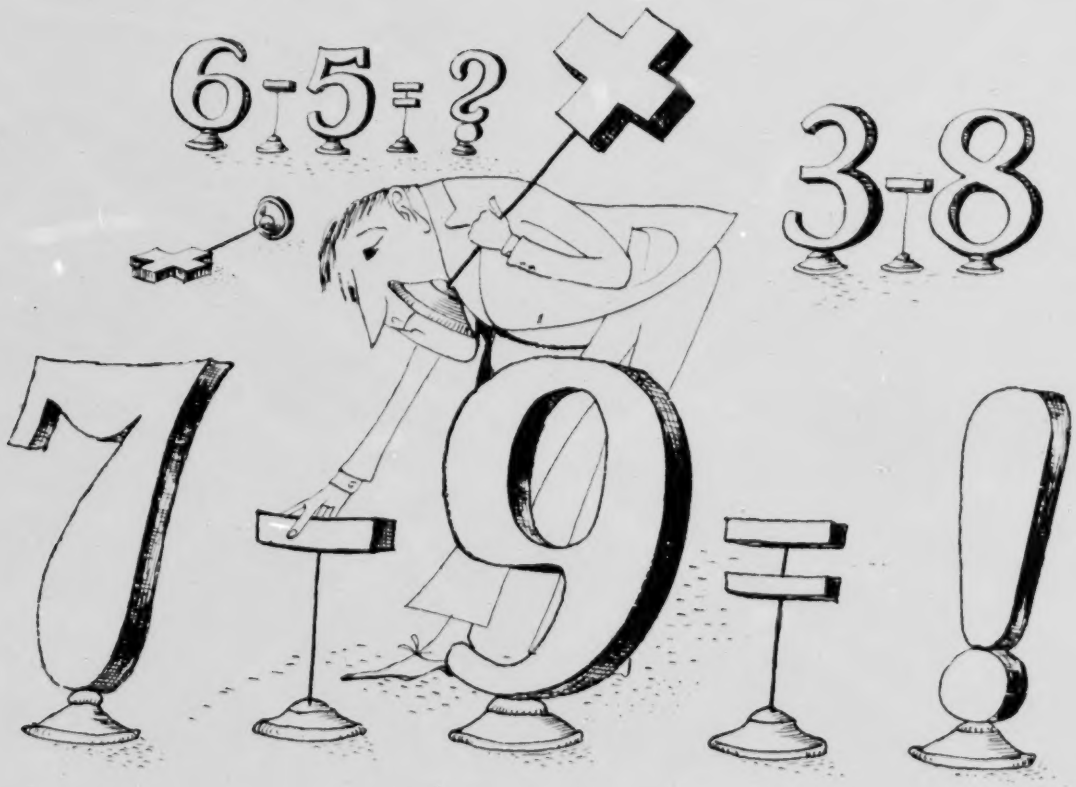

MATHEMATICS

Grade 7

Activity 1 - Have a student collect the United States census figures for each of the last 10 decades, ending with 1970. Divide the class into 10 groups and assign each group a decade. Have each group compute the percentage increase in the population of the United States in its decade.

- Develop a graph to show the data collected.
- What trends can be seen in the percentages that the students computed? Graph the rate of change.
- What guesses can be made as to what the population of the United States will be in the next decade? In the next 20 years?
- What factors have accounted for the change in the rate of population growth for the United States during the past two decades?
- Is the most recent percentage rate of population growth for this country a suitable one in terms of the effect population has upon the environment and resources? Explain.
- Compare this rate for the United States with that of a Western European nation, an African nation, and a Southeast Asian nation. Then, answer the preceding question in the context of the rates for these nations.

(*Environmental Understandings:* [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.])

(*Syllabus References:* Mathematics: Courses for the Seventh Year and Eighth Year; *Topic V, Ratio, Proportion, and Percent,* pp. 14-16)

Activity 2 - Have students request their parents to keep track of how much gasoline they use in a week in traveling to and from work. Divide the class into several groups of four or five students and have each group form a car pool using their parents' cars and gasoline consumption figures. Each group should figure the total cost savings and the percentage decrease in gasoline consumption as a result of their pool. Try the activity again using different groups of four or five students.

- What weighted average percentage saving resulted for the entire class?
- Was there any difference in the figures for the two different groupings? Explain.

- What obvious factors contributed to the variations in percentages when the car pool members were reassigned?

- Some of these factors would make certain car pool assignments impractical or even unworkable. Explain.

- Why do people live considerable distances from their places of employment? Do the benefits of such decisions usually outweigh the lack of economy and impracticality (both in terms of lengthening the work day and "draining dwindling resources") often inherent in such decisions? Why or why not?

(*Environmental Understandings:* [Man must acknowledge that the interdependence of all living things dictates the manner in which and the extent to which resources may be used.] [Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources.])

(*Syllabus References:* Mathematics: Courses for the Seventh Year and Eighth Year; *Topic V, Ratio, Proportion, and Percent,* pp. 14-16)

Grade 8

Activity 1 - Have students ask parents to let them bring in readings from electric bills over a period of 6 months. (If you think it advisable, render these bills anonymous by excising the addressee and address portion of the bills before using them.) Divide the class into groups and assign each group to one of the months. Have each group compute in kilowatt-hours the average use per household, the median, and the mode. Also have each group construct a histogram and a frequency polygon for the bills of its assigned month. Also, as a class exercise, compute the average usage and construct a histogram for the entire period covered.

- Were there any sharp increases for any month(s)? If so, what could account for these increases?

- Does a comparison of the figures indicate that attempts might have been made to conserve electrical energy?

- If so, do the dates of the bills which reflect this coincide with our recent energy crisis, or do they coincide with utility rate increases?

- What intangibles and variables must be anticipated or weighed before drawing hard and fast conclusions? Consider: vacations, size of family, and size of home.

- Consider how Americans might alter their patterns of excessive energy use.

(*Environmental Understandings:* [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.])

(*Syllabus References:* Mathematics: Courses for the Seventh Year and Eighth Year; *Topic VI, Statistics,* pp. 28-29)

Activity 2 - Have students contact their city, town, or village government to obtain the gross figures for the amount of water used during each of the last several years. Construct a frequency polygon or histogram using the results.

- Figure the mean, median, and mode from the data collected.
- Using the current estimated population of the community, determine the average annual use of water per person.
- To the extent that it is useful in considering water conservation practices, compute the daily per person water usage.

As a variation of this activity, have those students whose home water supply is metered bring their water bills for the preceding several years. Have the class compute the average, daily, per person use of water for the selected households. Construct a frequency polygon or histogram using the results. Instruct the class to figure the mean, median, and mode of the individual household data.

- Speculate as to what percentage of the water used might be wasted. What factors cause this water to be wasted and how might it be avoided?
- Describe several actions which might conserve water in the household. What percentage savings of water would these measures represent?
- How is the use of water related to energy consumption? Does this suggest that some types of conservation of domestic water use are more important than others?

(*Environmental Understandings:* [Most resources are vulnerable to depletion in quantity and quality.] [Any one of an environment's components, such as space, water, air, food, or energy, may become a limiting factor.] [Natural resources are interdependent and the use or misuse of one will affect others.])

(*Syllabus References:* Mathematics: Courses for the Seventh Year and Eighth Year; *Topic VI, Statistics,* pp. 28-29)

MATHEMATICS

Grade 9

Activity 1 - Provide the class with the following problem for solution. A trucking company specializes in hauling goods from Albany to Buffalo, a distance of 280 miles. If the truck drivers are paid $5.00 per hour, what percent increase in cost resulted from the change in the State speed limit from 65 miles per hour to 55 miles per hour (presuming, of course, that drivers adhered to the limits in both instances)?

- Why was the speed limit lowered?
- Who eventually absorbs the company's increased operating expenses? Explain.
- Do you think that these increased costs are partially offset by greater fuel economies? Explain.

(*Environmental Understandings:* [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [The material welfare and aspirations of a culture largely determine the use and management of natural resources.])

(*Syllabus References:* Ninth Year Mathematics, Course 1; *Topic III*, D., 9., p. 5)

Activity 2 - Suggest the following problem to the class. Based upon emission control standards for cars manufactured since 1970, the carbon monoxide in exhaust fumes should not exceed 4 percent. A recent test of a 1972 auto indicated that 150,000 cubic centimeters of an exhaust sample contained 7,000 cubic centimeters of carbon monoxide. Using the principle of proportions, determine by how many cubic centimeters the carbon monoxide count must be reduced to meet the 4 percent requirement.

- Have the standards for emission controls established by the Federal and state governments been realistic, manageable ones? Explain.
- What have been the objections of auto manufacturers to these standards?
- What effect have the emission control devices had on gasoline consumption? Explain.

(*Environmental Understandings:* [Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits.] [Choices between essential needs and nonessential desires are often in conflict.])

MATHEMATICS

(*Syllabus References:* Ninth Year Mathematics, Course 1 - Algebra; *Topic III, Algebra,* D., 8., p. 5)

Grade 10

Activity 1 - Divide the class into three groups. Give each group the problem of planning a fenced-in garden having a specified length of fencing available, e.g., 120 yards. Give directions as follows:

Group I: Design a triangular-shaped garden with as large an area as possible.

Group II: Design a quadrilateral-shaped garden with as large an area as possible.

Group III: Design a pentagonal-shaped garden with as large an area as possible.

- What triangle seems to have the largest area? What quadrilateral? What pentagon?
- What would have to be done to obtain the largest possible area for the garden?
- Discuss whether or not gardens, building [illegible] construction sites, highways, etc., are planned or des[illegible]d in a fashion which makes the most efficient use of available land.
- What consideration, other than efficiency (economically speaking), must be part of our land-use planning?

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [Any one of an environment's components, such as space, water, air, food, or energy, may become a limiting factor.])

(*Syllabus References:* Tenth Year Mathematics; *Topic II, Formal Geometry,* C., pp. 17-18)

Grade 11

Activity 1 - Give the students the following problem. An apple orchard now has 30 trees per acre, and the average yield is 400 apples per tree. For each additional tree planted per acre, the average yield per tree is reduced by approximately 10 apples.

-Write a function of x which represents the total yield of apples per acre if x represents the number of new trees planted per acre.

-Graph the function.
-Decide on the number of trees per acre which produces the maximum yield.

- What implications does the above procedure have for efficient use of land and resources?

- What is necessary in order for the above procedure to be applied?

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [Plants and animal populations are renewable resources.])

(*Syllabus References:* Eleventh Year Mathematics; *Topic II, Functions and Relations*, #10, pp. 6-7)

Activity 2 - When searching for problems which involve logarithms, consider several environmentally-related topics. Some of these topics which are concerned with exponential functions are: population growth, bacterial growth, and radioactive disintegration. As an example, have students work with the population growth formula as used in the following problem.

$$p = p_o \times a^{ct}$$

p = population
p_o = original population
a = rate of population growth (constant)
c = factor of proportionality
t = time elapsed

If the population of the United States in 1970 was 210,000,000, (p_o) and the annual rate of population growth, (a), is .62 percent, what will the expected population be in 1990? (t = 20 years.) (The factor of proportionality, c, is $\frac{1}{10}$.)

- How long will it take for the population of the United States to double?

- Graph the population growth of the United States from 1970 to 1990 using 5-year intervals.

- Suggest events that might take place which would alter the appearance of the graph developed in answer to the preceding question.

- Describe the appearance of the graph which would reflect each of these events.

- Estimate the current (1974) population of the United States.

- In terms of environmental impact, how would you describe this rate of population growth (.62 percent)?

- Obtain rates for other nations (in Europe, Africa, Asia, and Latin America) and compare them with the United States' rate. How soon will some of these nations experience a doubling of their populations?

(*Environmental Understandings:* [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [Earth's resources and recycling system can support only a limited number of people; therefore as populations increase and as resource supplies decrease, the freedom of the individual to use the resources as he wishes diminishes.])

(*Syllabus References:* Eleventh Year Mathematics; *Topic II, Functions and Relations*, #14-16, pp. 9-10)

Grade 12

Activity 1 - The following problem could be included in any twelfth year course in which introductory calculus is presented. A truck has a minimum speed of 20 miles per hour in high gear. When traveling x miles per hour in high gear, the truck burns diesel fuel at the rate of

$$\frac{1}{300} \quad \frac{2500}{x} + x \quad \text{gallons per mile.}$$

The truck cannot be driven over 75 miles per hour. If diesel fuel costs 33 cents a gallon, find:

-The steady speed that will minimize the cost of fuel for a 500-mile trip.
-The steady speed that will minimize total cost of the trip if the driver is paid $4.00 an hour.

- Which of the two speeds decided on above would be the natural choice of trucking companies today? Explain.

- Could the situation ever reverse itself? When and for what reasons?

(*Environmental Understandings:* [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.])

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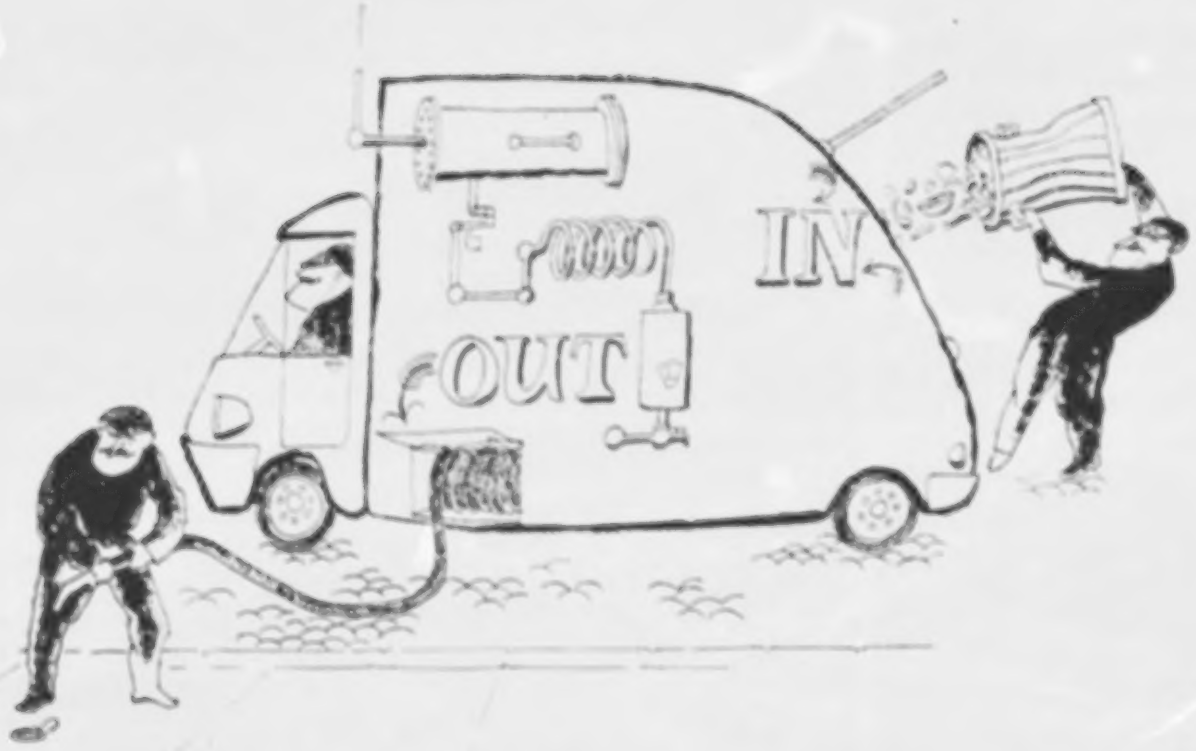


Grade 7 - Grade 9

Activity 1 - Ask two students to conduct the following activity for the class. Add identical quantities of ink to two beakers of the same size and mass, with identical quantities of water in them. Focus sunlight or high wattage lamp light onto one beaker. Place a candle under the second beaker. Take a temperature reading in each beaker and check the temperature of the water/ink mixture periodically. Have students compute temperature change and the rate of change. Calculate the number of calories involved in each method. Ask them to graph their results.

- Will the graphs intersect?
- If the graphs intersect, what is the relationship of the two beakers at that point? Explain.
- In each case, what was the main source of energy?
- Was the number of calories the same in each case? Why or why not?
- Which method of heating the water was most efficient in terms of energy conservation?
- How is water heated in your home?
- What would be the advantages and disadvantages of relying upon solar energy for heating water in the home?

(*Environmental Understandings:* [The earth's main source of energy is the sun.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.])

(*Syllabus References:* Science 7, 8, 9, Block K, Energy At Work; *V. Heat and Its Effect on Matter,* pp. 50-52 [A., B.]; p.64 [G.])

Activity 2 - Ask each pupil to keep an electrical energy log for one day. Every use made of an electric light or appliance should be recorded, giving wattage of the object and length of time used. For example:

APPLIANCE	WATTAGE	HOURS USED PER DAY
bedroom lamp		
television		
toaster		
radio		

Discuss with the class the modifications we have already experienced in our lifestyles due to the energy crisis, and suggest the probability that we will have to increase these cutbacks before suitable alternatives are found for generating electrical energy. Ask the students to consider the lists they compiled to see how they might alter their personal habits and conserve electrical energy. Have the class repeat the recordkeeping for an additional day. This time, everyone should make a conscious effort to save electricity. Pupils should calculate the wattage saved by some of their conservation practices. Stress the importance of being practical and realistic, and of aiming for a lifestyle that could be readily and comfortably maintained.

Distribute copies of the following chart and discuss how the students' daily use figures, multiplied by 365, compare with the amounts on the chart. Request explanations for major discrepancies.

Appliance	*Annual (Typical) Energy Consumption (kilowatt-hours)*	*Annual Cost of Energy Consumed**
Air conditioner	2000	$ 50.00
Electric blanket	150	3.75
Can opener	0.3	.01
Clock	17	.43
Clothes dryer	1200	30.00
Coffee maker	100	2.50
Dishwasher (with heater)	350	8.75
Fan (attic)	270	6.75
Fan (furnace)	480	12.00
Fluorescent light (3 fixtures)	260	6.50
Food freezer (16 cu. ft.)	1200	30.00
Food mixer	10	.25
Food waste disposer	30	.75
Frying pan	240	6.00
Hair dryer	15	.38
Hot plate (2 burner)	100	2.50
Iron (hand)	150	3.75
Light bulbs	1870	46.75
Radio (solid state)	20	.50
Radio phonograph (solid state)	40	1.00
Range	1550	38.75
Refrigerator (frost-free, 12 cu. ft.)	750	18.75
Sewing machine	10	.25
Shaver	0.6	.02
Television (black/white)	400	10.00
Television (color)	540	13.50
Toaster	50	1.00
Vacuum cleaner	45	1.13
Washer (automatic)	100	2.50
Totals	11,938 kw.-hrs.	$281.72

*Cost of electricity = $2\frac{1}{2}$ cents per kilowatt-hour

- Which appliances consume the most energy?
- Is this so because they are high wattage appliances or because they are used for greater lengths of time? Do some consume more energy for both of these reasons? Explain. (Multiply kilowatt-hours by 1,000 to determine watt-hours and then divide by the wattage of the appliance to determine hours of use. For example, toaster: 40 kilowatt-hours x 1,000 = 40,000 watt-hours ÷ 800 watts = 50 hours.)
- Which appliance was associated with the greatest neglect of turning off when not in use? Give possible reasons.
- What can be done, or is being done, to encourage the manufacture and marketing of longer-lasting and more energy-efficient appliances?
- What role can the consumer play in speeding up this process?
- How do utility companies handle shortages during peak consumption periods, such as hot spells when air conditioners are used extensively?
- What does it mean when "power" companies announce that they are cutting back the voltage by 3 percent or 5 percent?
- Will we ever have enough energy to be able to squander it as we have done in the recent past? Explain.

(*Environmental Understandings:* [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

(*Syllabus References:* Science 7, 8, 9, Block K, Energy At Work; *I. Electric Energy*, p. 22 [6., 7.])

Activity 3 - Instruct a group within the class to begin a file of magazine and newspaper articles related to the oil shortage in the United States. Special attention should be given to those articles which provide suggestions for increasing the availability of oil: exploiting Prudhoe Bay oil by completing the Alaskan pipeline; liquefying coal; mining oil shale; and increasing offshore explorations. Assign a panel of pupils to weigh the pros and cons of each of the possibilities suggested by the clippings. This panel could hear the arguments of three students selected to play the roles of, respectively, an oil company executive, a Sierra Club spokesman, and an official of a Federal licensing agency. Then, after the arguments have been heard and the panel has deliberated, conduct a secret ballot among the class to determine the practicality or feasibility of each suggestion. The research activities implicit in this exercise should provide answers to the following questions:

- How do we obtain the figures we use concerning the availability of oil?
- What do the terms, "reserves," "proved reserves," "probable reserves," and "future discoveries" mean?
- How reliable would you judge figures (in billions of barrels) assigned to each of these terms to be?
- What would be the environmental impact of exploiting each of the suggested alternative oil sources?
- What technological problems would have to be solved before oil from oil shale could be obtained in an economically and environmentally efficient manner?
- Why are environmentalists opposed to offshore drilling?
- What are the trade-offs that must be considered in the decisions about using these alternative sources of fuel?
- What factors might determine whether coal could and should be used rather than attempting to obtain oil from these alternate sources?

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.] [Natural resources are interdependent and the use or misuse of one will affect others.])

(*Syllabus Reference:* Science 7, 8, 9, Block E, Our Planet Earth; *I. The Earth's Surface*, p. 12 [3.])

Activity 4 - Assign several committees of students to do research about quantities of solid waste accumulated by (1) their school (2) their families, and (3) the community in one day. The data related to school and home will probably be in terms of volume (number of bags). Find out from the local sanitation department whether they measure solid waste in volume or weight. Have students weigh some of the bags of trash from home and school, and determine averages.

Consider the contents of a typical wastebasket or trash bag. Discuss whether all of the material consumed by our society is necessary. An interchange of ideas should lead to the understanding that many factors are involved in making such a judgment, and that personal values and priorities will influence the answers. Select a few items about which there is considerable difference of opinion, and have one committee list the positive reasons for using the items versus the environmental impact of their use. Economic factors, resource use, energy use, and

disposal problems should all be included on this "environmental balance sheet." Encourage students to suggest alternatives wherever the balance sheet shows waste. Use the following questions:

- What raw materials and how much energy were used in manufacturing the products which are now waste?
- Are these waste materials recyclable? Explain.
- Where is the community's landfill site? What is its capacity? How much waste is deposited here daily? Yearly? What happens when this site is no longer usable?
- How much energy was consumed in transporting the product from the factory to the store?
- What is the purpose of the product? Could the same purpose be served in a less wasteful way? If not, what advantages does the product have?
- What jobs would be affected if this product were no longer made? Are the industries involved in the manufacture of the product diversified; that is, could the people and equipment used in manufacturing the product be "retooled" easily to manufacture a more vital product?
- Could the product, along with other solid waste collected by the community be used as fuel for generating electrical energy and supplying heat? Cite examples.
- Would more energy be generated than would be expended in transporting and incinerating the trash?
- Are there cities where trash is being used for fuel? Are these attempts successful? If not, what are the problems, and how can they be overcome?
- Has discussion begun, or have any steps been taken, in this direction in your own community? Do you consider this method of generating electricity, and of disposing of solid waste, worthwhile enough to merit further research?
- How can you as a citizen encourage the city to look into the use of trash as a source of fuel and as a soil conditioner?
- Does it appear that it would be possible for our society to continue to consume as we have been doing? Explain.

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [The renewable resource base can be extended by reproduction, growth, management, and recycling.])

(*Syllabus Reference:* Science 7, 8, 9, Block J, The Chemistry of Matter; *VI. The Role of Chemistry in Society,* p. 66 [A., B., C.])

Activity 5 - Set up a demonstration using electrolysis of water to obtain oxygen and hydrogen. One method of doing this is to use the Hoffman apparatus and 6-8 volt direct current. Note the volume of gas at the anode and at the cathode. Test for hydrogen and for oxygen.

Discuss the problem of using hydrogen as an energy source. Use the following questions as a basis for student research and class discussion:

- From what sources, other than water, can hydrogen be obtained?
- How can electrolysis of water for hydrogen production be used in connection with nuclear power plants?
- What is the environmental impact of hydrogen as an energy source? (Included in the discussion of this question might be such factors as its nonpolluting qualities, its abundance, the possibility of using waste as a source of hydrogen, and the connection between hydrogen as an energy source and other "limitless" but variable sources such as sun and wind.)
- To what extent is hydrogen now being used as an energy source?
- Why is hydrogen not used more generally at this time?

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources.])

(*Syllabus Reference:* Science 7, 8, 9, Block J, The Chemistry of Matter; *V. Common Compounds and Mixtures,* p. 56 [2.])

Activity 6 - Have the class develop an annotated "timeline" of the past and projected uses of nuclear energy in the generating of electricity. This chronology might start with the breakthroughs which led to the atomic bomb, or might begin in 1946 when the United States Atomic Energy Commission was initiated. It should include the establishment of nuclear power plants, the potential of the breeder reactor, and expectations related to fusion as a source of electrical energy.

In preparing the annotations, research should be done by various committees using the following questions as guides:

- Where was the first nuclear power plant located?

- How many nuclear power plants are there in the United States at this time? In New York State? (Place markers on a State map.)

- What percentage of the electricity in the United States is produced by nuclear power? How does this figure compare with the expectations for nuclear power several decades ago? How can this discrepancy be accounted for?

- In general, what are the advantages and disadvantages of conventional nuclear power plants?

- In what specific cases did communities in New York State prevent or delay the establishment of nuclear power plants? What were the objections raised by these communities?

- What are breeder reactors? How do they operate? What waste results from breeder reactors and how is it disposed of?

- In what ways do breeder reactors meet some of the objections to conventional nuclear plants? In what ways do they present other, and greater problems?

- What is fusion? How does it occur naturally? What research is being done to develop fusion as a source of electrical energy?

- What are the advantages of fusion as a potential source of electrical energy?

- What are the present expectations concerning the possibility of fusion as a practical source of electrical energy?

- What are your opinions concerning the environmental dangers associated with fission and breeder reactors and the large expenditure of time and money required for research and development as contrasted with our pressing need for new sources of energy?

(*Environmental Understandings:* [Natural resources are interdependent and the use or misuse of one will affect others.] [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.] [Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources.])

(*Syllabus References:* Science 7, 8, 9, Block L, Living With The Atom; *III. Nuclear Fission*, pp. 28-31 [A., B., C.]; *VI. Radiation Safety*, pp. 40-41 [A.]; The General Science Handbook, Part 2, *Activity 2427*, p. 82)

Activity 7 - Assign a small group of interested students the project of designing the "house of the future." As architects working on construction planned for A.D. 2100, they must be concerned with

the scarcity, and in some cases the nonexistence, of many resources currently used. Also, future lifestyles must be considered.

To stimulate student imagination, the teacher might suggest that the walls of the house be constructed from a mixture of recycled paper with plastics and sand (70% paper, 20% plastics, 10% sand). It might also be suggested that the floors be constructed of a material including recycled glass mixed with sawdust (90% glass, 10% sawdust).

Use the suggested questions below to plan the first phase of the activity. Encourage creativity and imagination!

- List all construction materials. What new (recycled) materials will be used for the frame, roof, floors, windows, walls, ceilings, and doors? How will they be manufactured?

- Design the heating and cooling system. What new (recycled) materials will be used? How can the system be made extremely compact? Pay special attention to insulation.

- Describe and design samples of home furnishings including: chairs, tables, beds, and others. What new styles can be introduced to make use of recycled materials?

For the second phase of the project, have students prepare scale drawings of floor plans for the "house of the future" as described above. (It might be advantageous to have the students use the metric system for all measurements.)

As a possible third phase of the project, students might be asked to do research on new sources and methods of providing the house with energy for heating and operating mechanical devices. The following possibilities might be investigated.

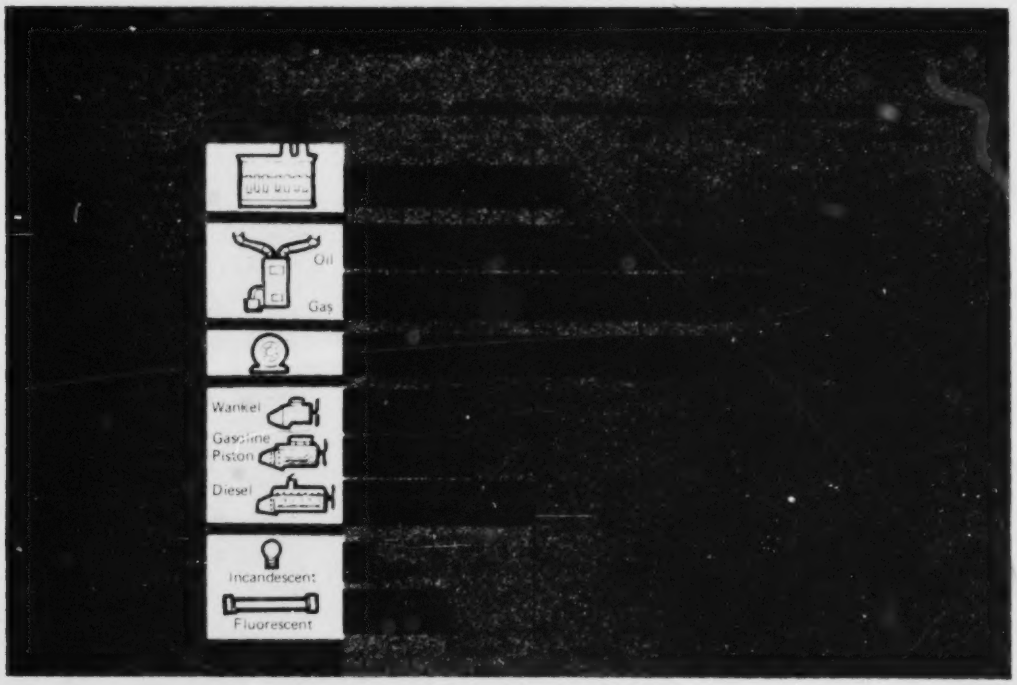
-solar energy satellites
-geothermal power
-wind and tidal power
-solar furnaces

Some students may be interested in designing a house for use in outer space.

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [The renewable resource base can be extended by reproduction, growth, management, and recycling.])

(*Syllabus References:* Science 7, 8, 9, Block K, Energy at Work; *V. Heat and Its Effect on Matter,* pp. 50-64 [A.-G.]; Science 7, 8, 9, Block J, The Chemistry of Matter; *VI. The Role of Chemistry in Society,* p.66 [B.])

Activity 8 - Review with the class the scientific definition of efficiency. Duplicate, or make a transparency of, the graph below. Discuss what happens to most of the energy which is wasted.



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Suggest that students speculate about several ways in which communities or utility companies could increase the efficiency of electrical generating plants and transmission systems.

Plan with the class a science fair with the theme, "Using Our Dwindling Resources More Efficiently." The exhibits should represent energy generation, insulation in the home, home heating systems, industrial processes, and transportation. Encourage imagination and creativity in the design of systems which might be used in the average household.

- How does the substitution of electricity for fuels, such as coal and gas, affect the use-efficiency of our natural resources?
- What adverse environmental effect does the waste heat from a nuclear plant have on the water into which it is discharged?
- Of the items included in the graph shown above, which is the least efficient? Why?
- Using the graph and the knowledge that the average American home uses 18 percent of its total electrical consumption (kilowatt-hours) annually for lighting, calculate the economic waste involved. (Have students ask their parents, or telephone the local utility company, to determine what the cost is per kilowatt-hours.)

- Consider what might happen to the Hudson River Valley area if the temperature of the Hudson River were increased to 37° Celsius and maintained at that temperature over a period of time.

- Hold a laboratory thermometer next to, but not touching, light bulbs of different wattage. What is the thermometer reading for a 40-watt bulb? For a 60-watt bulb? For a 100-watt bulb? How can this heat loss cause further energy waste during the summer?

(*Environmental Understandings:* [The waste of natural resources can limit the options available to future generations.] [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.])

(*Syllabus References:* Science 7, 8, 9, Block I, Forces At Work; *II. Forces and Work*, p. 22 [5.]; The General Science Handbook, Part 2, *Activities 3317-3333*, pp. 81-87)

Activity 9 - Simple machines can be used to demonstrate the concept of efficiency. Have small groups of students determine the efficiency of inclined planes with different surfaces (rough to smooth) and pulley systems. Ask the students to answer the following questions relating to each of these simple machines.

- Compute the input and output of each machine. What is the loss of energy in each case?

- How is the efficiency of a machine determined?

- List several ways in which efficiency can be increased. What factors decrease efficiency?

- What was the maximum efficiency (percentage) obtained for each simple machine?

Expand the discussion to include more complex machines.

- Give as many reasons as you can to explain why some automobiles run 30 miles on a gallon of gasoline while others run only 12 miles on a gallon. Why is it important to get maximum mileage?

- Explain why better-paved roads might improve the gas consumption of automobiles. Is this increase significant in terms of conserving fuel? Explain.

Using the diesel engine as an example, ask an interested student to investigate the following and report his findings to the class.

-percent of available fuel energy used in producing useful work

-recent research which suggests ways of increasing the efficiency of the diesel engine
-extent of the available supply of diesel fuel
-reasons for the increase in the cost of diesel fuel
-ways of conserving diesel fuel supplies

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.])

(*Syllabus Reference:* Science 7, 8, 9, Block I, Forces At Work; *II. Forces and Work*, pp. 18-34 [D.-F.])

Activity 10 - Obtain some of the silicon-type solar cells and hook into an appropriate voltmeter-ammeter circuit. Calculate the power output of the battery at different times of the day, at different angles to the sun, or with incident light of similar intensity and spectral fidelity to the sun. Calculate the costs for sufficient solar cells to meet a typical electrical consumption bill for a class member's home. Calculate the area in square meters that the solar batteries would require when installed.

- What are the advantages of solar battery produced electrical energy?
- What are the disadvantages?
- Assuming that storage batteries could be installed in a home to hold energy for cloudy weather, what problems remain in installing solar batteries for home energy supply?

(*Environmental Understandings:* [The earth's main source of energy is the sun.] [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.])

(*Syllabus Reference:* Science, 7, 8, 9, Block G, Living in the Space Age; *II. Principles of Space Travel*, pp. 38-40 [3.])

EARTH SCIENCE

The three activities which follow consist of references to investigations which are found in the Supplement (Part 2, Topics 5-8) to the Earth Science Syllabus. As you use these investigations in their appropriate place in your program, consider the questions which accompany them below by way of making them serve additionally the objective of examining our present energy and resources dilemma.

Activity 1 - Undertake investigation V-A-1a: Electromagnetic Spectrum.

- How does the sun's energy shape the earth's surface?
- In what ways does the sun's energy benefit man?
- Does energy from the sun hinder man or his activities in any way? Explain.

Activity 2 - Use investigation V-A-20: Heat Transfer.

- List ways in which heat energy is lost in your home heating system. How can these losses be reduced?
- Based upon simple inquiries you might make, rate different types of home heating in the order of their efficiency.
- Could major strides in the conservation of energy resources be made if we were more attentive to the way we build houses, fuel industry, and construct heating systems? Explain in detail, offering specific suggestions.

Activity 3 - Do investigation VI-A-1a: Angle of Insolation.

- Based upon what you have learned from this activity, how could man use the sun's energy to heat his home?
- In what other ways might man benefit from the direct use of solar energy?
- Certain U.S. Government officials have indicated that research and development of solar energy is not advancing because of the absence of a "sun lobby" in Washington. What is meant by a "sun lobby?" Enumerate some activities that it might perform. What can concerned citizens do to activate such an organization?

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.])

(*Syllabus References:* Earth Science Syllabus, *Topic V - Energy in Earth Processes*, A-1, A-2, pp. 16-17; *Topic VI - Insolation and the Earth's Surface*, A-1, pp. 19-20)

Activity 4 - Good land usage planning is an important aspect of environmental conservation and improvement. Conduct a class discussion on planning practices with the aid of the map and questions given below.

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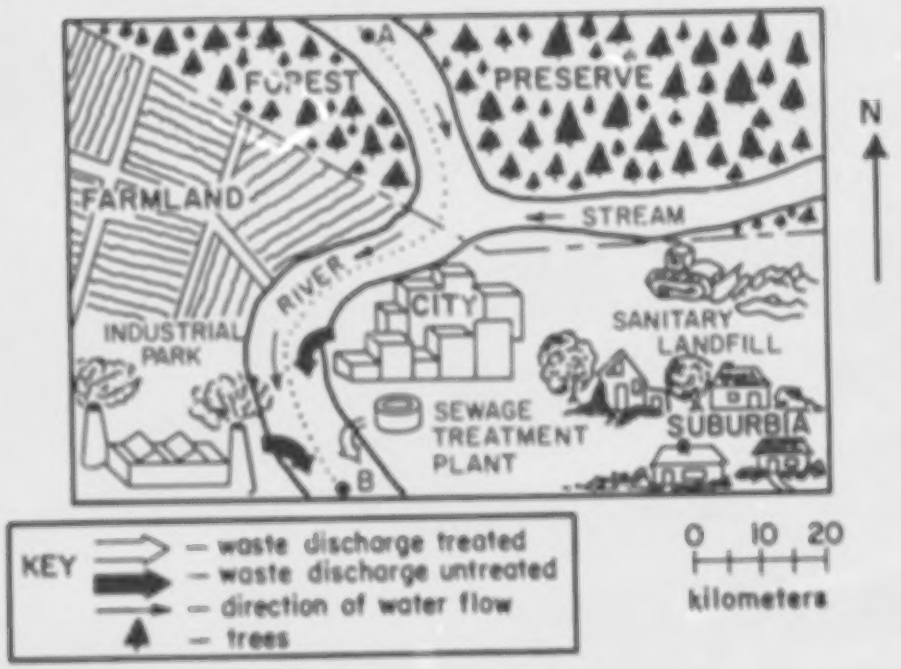
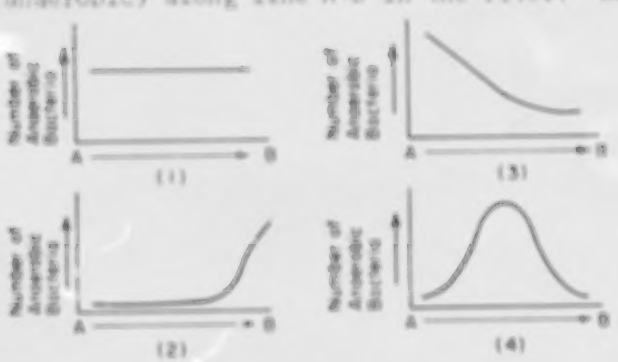
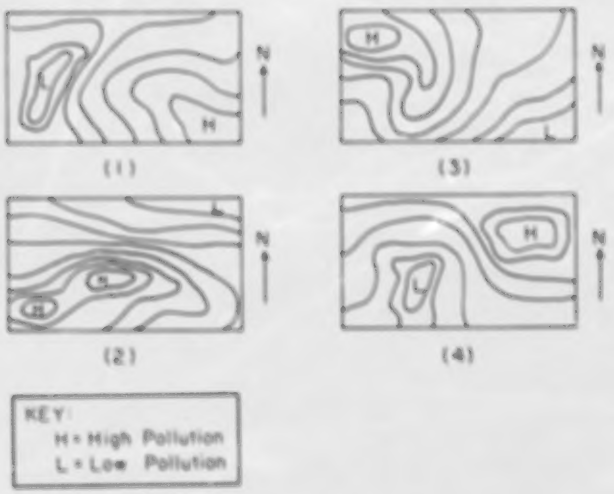


- Does the map represent a well-planned area? Explain. What changes could be made to improve the area's environmental quality?
- Which landscape region has probably been altered least by the activities of man? Explain.
- What effect would a second industrial park have upon the environment?
- Should people living here support legislation to rezone this land to allow for a second industrial park? Why or why not? Give some advantages and disadvantages.
- Which graph best represents the probable quantity of bacteria (anaerobic) along line *A-B* in the river? Explain.



- What causes the change in the bacterial count between points *A* and *B*? Who has the responsibility for monitoring and, if necessary, remedying the condition?



- What are the principal causes of the air pollution? Who is responsible? What actions can the governmental agencies (and citizens) involved take to improve the quality of the air?

- Compare the surface runoff rates during a 1-hour light rain of the four areas (forest preserve, suburban, city, and farmland) by arranging them in order from most to least runoff. Explain your reasoning.

(*Environmental Understandings:* [The limited nature of productive resources makes it imperative that a society defines its economic objectives in terms of environmental reality.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.] [Soil, trees, and water are classified as renewable resources, but, because their renewal or revitalization requires a major investment in time and effort, they may be more realistically considered depletable resources.])

(*Syllabus References:* Earth Science Syllabus: *Area 1, Investigating Processes of Change*, C., Environmental Change, p. 5)

BIOLOGY

NOTE: It is quite obvious that the entire Biology program generally nurtures environmental education objectives. This is especially true of classes which devote considerable time to Unit 7 of the Biology Secondary Schools Syllabus. The activities which follow are offered as highlights and illustrations of certain subobjectives in environmental education (understanding energy problems, considering the limits of natural resources, etc.) which can be served by the Biology program.

Activity 1 - Competition characterizes life in a natural community because organisms use the same limited resources such as food, space, water, and light. Given the community, or communities, of a small woodlot adjacent to the school or in a park area, instruct the students to list the members of the community and to note the resources for which they compete. They should then develop a chart using the information gathered and make predictions about the future of the community along the lines of the following questions.

- Are any of the resources being used considered limiting factors for the organisms? If so, which factors and which organisms?
- Which, if any, of the organisms might eventually be eliminated due to these limiting factors?
- Describe a likely action (encroachment) of man upon this woodlot community which might increase the number of limiting factors or their severity in terms of the organisms' well-being.
- Describe the types of close association (symbiosis) which are represented among the organisms in the community (commensalism, mutualism, parasitism).
  NOTE: The students might enjoy describing human relationships in family, institutions, and in society generally wherein some of the features of these symbiotic associations are approximated. Additionally, such an exercise could help reinforce understanding of the terminology.
- Which, if any, of a natural community's resources are finite or nonrenewable?
- Could the population of one or more of the community's organisms increase to the extent that the community's resource base is threatened? Explain. Is this a phenomenon which bodes ill for human populations? Explain.

(*Environmental Understandings:* [Any one of an environment's components, such as space, water, air, food, or energy, may become a limiting factor.] [Man must acknowledge that the interdependence of all living things dictates the manner in which, and the extent to which, resources may be used.] [Earth's resources and recycling system can support only a limited number of people; therefore, as populations increase and as resource supplies decrease, the freedom of the individual to use the resources as he wishes diminishes.])

(*Syllabus References:* Biology; *Unit 7 - Plants and Animals in Their Environment, II. Biotic Organization, pp. 95-97* [A., B., C.1.a.]; Biology: A Handbook of Activities, *Activities 2.17-2.22*, pp. 112-115)

Activity 2 - The movements of energy, which characterize life activities, are represented in the food chain and web. Discuss with the class the transfer of energy in a food chain, including the concepts of producer, consumer, and decomposer. Relate the activities of one of these, e.g., decomposer, to the concept of competition. Substantiate observations about these concepts and implicit understandings through the activities referred to in the *Syllabus References* below.

- What is the essential source of energy in a natural community and how is it produced?
- How is energy lost in a food chain or web?
- What is the pyramid of energy?
- Does man lose or waste significant amounts of energy in the course of his various technological processes? Explain, giving examples.
- How does man's efficiency in energy use compare with nature's? (Euell Gibbons, in his new book, *Stalking the Far Away Places*, suggests ways man might profitably emulate nature's efficiency with regard to energy production and use.)
- As to the matter of competition, are there any parallels between competition in a natural community and competition in the society of man? Explain.
- How does man resolve his disputes over resources and energy?
- Reconcile (if you can) the following statement with what you know to be true about the environment, natural communities, and man's place in the biosphere:

  "If it comes to a choice between energy and the environment, I think we will choose energy."

(*Environmental Understandings:* [Natural resources are interdependent and the use or misuse of one will affect others.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [Man must acknowledge that the interdependence of all living things dictates the manner in which, and the extent to which, resources may be used.] [Living things are interdependent with one another and with their environment.])

(*Syllabus References:* General Biology, *Understandings 17-19*, pp. 12-13; *Activities 17.0-19.1*, pp. 12-13; Biology, *Unit 7 - Plants and Animals in Their Environment, II. Biotic Organization*, pp. 97-99)

[c.1.b. (1)] High School Biology, BSCS Green, Student's Manual, Exercise 3.2, pp. 57-59)

Activity 3 - Instruct members of the class to prepare illustrations of various Material Cycles which occur in an ecosystem. (Those which might be used are the Nitrogen, Oxygen, Carbon, Hydrogen, and Phosphorus Cycles.) Lead a general class discussion of materials cycles using the illustrations.

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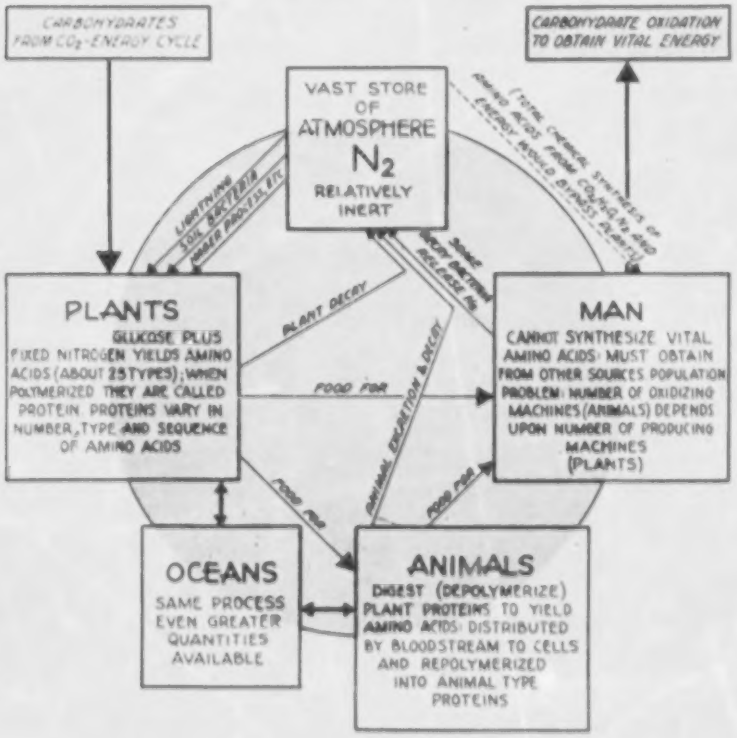
THE NITROGEN CYCLE


CARBOHYDRATES FROM CO_2-ENERGY CYCLE
CARBOHYDRATE OXIDATION TO OBTAIN VITAL ENERGY
VAST STORE OF ATMOSPHERE N_2 RELATIVELY INERT
LIGHTNING SOIL BACTERIA
PLANTS
GLUCOSE PLUS FIXED NITROGEN YIELDS AMINO ACIDS (ABOUT 25 TYPES); WHEN POLYMERIZED THEY ARE CALLED PROTEIN PROTEINS VARY IN NUMBER, TYPE AND SEQUENCE OF AMINO ACIDS
PLANT DECAY
FOOD FOR
MAN
CANNOT SYNTHESIZE VITAL AMINO ACIDS MUST OBTAIN FROM OTHER SOURCES POPULATION PROBLEM: NUMBER OF OXIDIZING MACHINES (ANIMALS) DEPENDS UPON NUMBER OF PRODUCING MACHINES (PLANTS)
ANIMAL EXCRETION & DECAY
FOOD FOR
OCEANS
SAME PROCESS EVEN GREATER QUANTITIES AVAILABLE
ANIMALS
DIGEST (DEPOLYMERIZE) PLANT PROTEINS TO YIELD AMINO ACIDS DISTRIBUTED BY BLOODSTREAM TO CELLS AND REPOLYMERIZED INTO ANIMAL TYPE PROTEINS

Ask the following questions pertaining to the Nitrogen Cycle:

- Why do animals (and man) need nitrogen?
- How do they obtain this nitrogen?
- Free nitrogen constitutes 78 percent of the air. Can this nitrogen be used by plants and animals? Explain.
- How do plants obtain nitrogen?
- Name some scavengers, decomposers, and saprophytes and explain their role in the Nitrogen Cycle.

- Does man effectively recycle the materials he uses?
- In what ways may we achieve more efficient use of our resources through recycling?
- Select some form of recycling process conducted by man, and explain what steps approximate those roles performed by scavengers and decomposers in the Nitrogen Cycle.
- Why is it necessary that society become aware of the extreme importance of recycling?

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [Natural resources are interdependent and the use or misuse of one will affect others.] [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.]

(*Syllabus References:* Biology, *Unit 7 - Plants and Animals in Their Environment, II. Biotic Organization*, pp. 99-100 [c.1.b. (2)]; Environmental Education Instructional Activities, 7-12, *Recyclement, Activities 1-8*, pp. 19-24; Biology: A Handbook of Activities, *Activities 2.12, 2.13*, p. 110 General Biology, *Understandings 27, 28; Activities 27.0-28.1*, pp. 15-16 High School Biology, BSCS Green, Student's Manual, Exercise 7.4, pp. 125-128)

Activity 4 - Use Laboratory Activity S-37, pp. 78-79 in Patterns and Processes (BSCS), and discuss further the results and observations in terms of the following questions:

- Do the nuts contain stored energy?
- Where did this stored energy originate?
- Trace the energy from its origin to its storage state in the nut, describing each step.

Have the students do Reading S-38 on page 80.

- Does food supply all of man's metabolic energy requirements? Explain.

(*Environmental Understandings:* [Energy is initially supplied to an ecosystem by the activities of green plants.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.])

(*Syllabus References:* Patterns and Processes (BSCS), *Laboratory Activity S-37*, pp. 78-79, *and Reading S-38*, p. 80; Biology, *Unit 2 - Maintenance in Animals, I Nutrition*, pp. 17-19, 20-22 [A., C.]; General Biology, *Unit 2 - Systems of the Human Body, Understandings 29-30*, p. 19; *Activities 29.0-30.0*, p. 19)

Activity 1 - Ask an interested student to determine the number of kilocalories of energy produced by the neutron-induced fission of one kilogram of $^{235}_{92}U$. Supply him with the information given below, and request that he explain his calculations to the class.

The nuclear equation for the neutron-induced fission of $^{235}_{92}U$ is

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{141}_{56}Ba + ^{92}_{36}Kr + 3\ ^{1}_{0}n + 4.61 \times 10^{9}\ \frac{kcal}{mole}.$$

This reaction releases about 200 million electron volts per atom (fission).

1 electron volt = 1.60×10^{-19} joules.

1 joule = 2.39×10^{-4} kcal.

Convert 200 million electron volts to kilocalories.

$$2.0 \times 10^{8}\ \frac{\cancel{ev}}{atom} \times 1.60 \times 10^{-19}\ \frac{\cancel{joule}}{\cancel{ev}} \times 2.39 \times 10^{-4}\ \frac{kcal}{\cancel{joule}} = 7.65 \times 10^{-15}\ \frac{kcal}{atom}$$

6.02×10^{23} atoms = 1 mole = 235 grams of $^{235}_{92}U$.

$$7.65 \times 10^{-15}\ \frac{kcal}{\cancel{atom}} \times 6.02 \times 10^{23}\ \frac{\cancel{atoms}}{mole} = 4.61 \times 10^{9}\ \frac{kcal}{mole}$$

$$4.61 \times 10^{9}\ \frac{kcal}{\cancel{mole}} \times \frac{1\ \cancel{mole}}{.235\ kg} = 1.96 \times 10^{10}\ \frac{kcal}{kg}$$

Using the table below ask a second interested student to determine how many kilograms of gasoline, coal, oil, or alcohol are needed to release the same amount of energy.

SOURCES OF ENERGY

coal	$5.6\ \frac{kcal}{kg}$
gasoline	$11.0\ \frac{kcal}{kg}$
fuel oil	$10.6\ \frac{kcal}{kg}$
alcohol	$5.5\ \frac{kcal}{kg}$

- Which of the above four fuels produces energy in the most efficient manner? The least efficient manner? Explain.
- How does the energy-producing efficiency of each of the four fuels compare with that of the neutron-induced fission of $^{235}_{92}U$?

- What are the future prospects of producing large quantities of energy by fission? What are some of the obstacles that may impede progress to this end?
- Where should funds come from to accelerate research in this field? Justify your answer.
- What precautions must be taken to protect the environment?
- What are some of the advantages that may eventually accrue (environmentally) if technology is able to perfect the process?
- Describe some possible changes in lifestyles that may result. What factors may bring these about?
- What are some of the arguments advanced by critics of expanding the production of nuclear energy? Are they justified? Explain.

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [The renewable resource base can be extended by reproduction, growth, management, and recycling.])

(*Syllabus References:* Chemistry; *Unit 2 - Atomic Structure,* C. Structure of Atoms, pp. 9-11)

Activity 2 - The United States has invested billions of dollars for the development of nuclear energy. Ask interested students to prepare class reports on the role of nuclear energy in the following fields:

-national defense
-electrical energy
-industry
-medicine
-agriculture

- Compare the amounts spent on nuclear energy for national defense with that spent for all other purposes. (Graph results.) What are the implications of the comparison?
- Should the Government be encouraged to spend more money for the expansion of peace-time uses of nuclear energy? Explain.
- Should industry be similarly encouraged? Why? What incentives might be used?

(*Environmental Understanding:* [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

(*Syllabus References:* Chemistry; *Unit 1 - Matter and Energy,* II., Energy, pp. 1-2)

PHYSICS

Activity 1 - Have the students bring battery-powered toys and appliances for testing. Voltage may usually be determined by the arrangement and number of dry cells used. Current readings may be determined if the circuit can be carefully interrupted by placing an appropriate ammeter in series next to the cell or battery. Calculate the power used by the various items tested. *Caution:* Under certain conditions, battery-powered toys and appliances may present a health hazard (shock). Particularly dangerous are circuits that employ capacitors. Teachers unfamilar with the precautions and dangers involved should not use this activity.

- Is there a significant difference between power requirements of appliances or toys that perform similar functions? Why?
- Do the power requirements for a given type of device vary from manufacturer to manufacturer? Why?
- Do the power requirements for a given type of device vary significantly when produced by the same manufacturer? Why?
- Are there design problems that manufacturers should consider to improve energy conservation in their appliances? Explain.

(*Environmental Understandings:* [The renewable resource base can be extended by reproduction, growth, management, and recycling.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.])

(*Syllabus Reference:* Physics; *Topic II, Electric Current,* F. Resistance, pp. 34-35)

Activity 2 - Use some sample nuclear fission reactions to illustrate the fission fragments and energy produced by such a reaction. Using the $E = mc^2$ relationship, calculate the energy equivalent of an atomic mass unit. Carry the exercise further by calculating the energy equivalent of the mass of a single proton converted to energy. Given the fact that a 1-gram sample of a certain radioisotope fuel produces 2 watts per gram during 8 years, calculate the energy in joules produced by the radioisotope during the 8-year period. For comparison, consider gasoline burned with air as generating 10,000 joules/gram of combustion products, and calculate the amount of gasoline and air required to equal the 8-year output of the 1 gram radioisotope.

- What are the advantages of using fission and fusion systems for producing energy?
- What are the disadvantages?
- Considering the availability and future prospects of availability of all materials used in the various exercises above, which process of creating energy is the most promising at this time? Explain.

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.])

(*Syllabus References:* Physics; *Topic VI, Nuclear Reactions,* D. Mass-Energy Relationship, p. 55; F. Nuclear Fission, p. 57)

Activity 3 - Inasmuch as we must begin considering alternatives to the use of fossil fuel for energy, it would be useful to examine the potential of solar energy. Have the pupils determine the amount of energy (from the sun) per minute that falls on a square meter of the earth's surface. (Answer: Approximately 4.47×10^4 watts)

- Where does the sun get its energy?
- How much of the sun's energy is falling on a square meter of earth for a 10-hour period?
- How much gasoline would be needed to supply the same amount of energy measured in the preceding question?
- How do photoelectric cells and solar batteries make use of solar radiation?
- What are the problems that would need to be surmounted before solar energy could supplant other types of energy on a large scale?

(*Environmental Understandings:* [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [The earth's main source of energy is the sun.])

(*Syllabus References:* Physics; *Topic IV, Work and Energy,* A. Work, p. 8; B. Energy, p. 8; C. Power, p. 9)

Activity 4 - Most families receive either a monthly or bi-monthly energy bill from their utility company. Those homes using fuel oil or bottled gas usually receive still another bill for energy supplies.

Ask the students to find out the total energy consumption for their families in terms of raw materials and kilowatt-hours of electricity consumed in 1 month. Compute a class total for cubic feet of gas (natural and/or bottled), oil, and electricity. Assume complete combustion and 100 percent efficiency in heating fuels and convert all energy to joules.

- What is the percentage of variation (difference in percent between the lowest and highest consuming family) for the group?

- When considering the total number of family members represented by the class enrollment, what is the energy consumption in joules/day/person?

- What are some of the reasons for differences in energy consumption between people? Between families? Between societies?

- Explain how some of the factors contributing to energy shortages can be ameliorated through careful study of these reasons cited.

(*Environmental Understandings:* [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [Choices between essential needs and nonessential desires are often in conflict.])

(*Syllabus Reference:* Physics; *Topic II, Electric Current,* G. 6. Electric Energy and Heat, p. 37)

Activity 5 - The two most popular methods of home illumination are the fluorescent tube and the incandescent bulb. Using a fluorescent tube and an incandescent bulb of the same wattage, compare the intensity of illumination of each with a photoelectric device.

- Which type of bulb provides the greatest illumination for the amount of energy consumed per unit time (power)?

- Which type of bulb is most widely used in business and industry? Why?

- Which type of bulb is most widely used in home illumination? Why?

- What are the disadvantages of the incandescent bulb?

- What are the disadvantages of the fluorescent tube?

- What might some lamp designs look like that would use fluorescent bulbs yet retain some of the design characteristics of traditional home lighting fixtures?

- Would serious consideration of such designs be appropriate action to the end of energy conservation? Why?

(*Environmental Understandings:* [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.]

(*Syllabus Reference:* Physics; *Topic II, Common Characteristics of Periodic Waves,* pp. 16-18)

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Activity 6 - Home insulation has a pronounced effect on energy conservation, particularly during the winter months when there is a significant temperature difference between indoors and outdoors. Have students compare heat losses from calorimeter-type cans of heated water when insulated with various thicknesses of fiberglass insulation, fiberglass insulation with foil, foil alone, and vermiculite. Calculate the kilocalories lost per unit of time for different thicknesses and graph the results. Convert the kilocalories of heat to kilowatt-hours and determine costs for energy losses. Calculate the differences in costs for the various insulators used.

- What types of insulation are the most effective?
- What does the curve of fiberglass insulation thickness versus heat loss look like?
- What does the curve of fiberglass insulation thickness versus cost look like?
- What can be illustrated by superimposing the two curves?
- How do the budgetary aspects of paying for energy differ from buying insulation (when constructing a new house)?
- What would be some methods for encouraging home owners to insulate their homes better? (e.g., making insulating costs a deductible item for income tax purposes—an idea which has some currency in Washington at the present time)

(*Environmental Understandings:* [Individuals should become well informed about the best ways to manage and conserve our energy supplies.] [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.])

(*Syllabus Reference:* Physics; *Topic VI, Internal Energy and Heat,* D. Exchange of Internal Energy, p. 12)

Activity 7 - Electrical energy losses occur as electricity is moved through conductors. Energy losses of this type are frequently ignored in circuit calculations in elementary physics. Yet there are significant losses to be considered in moving electricity from generator to consumer. Arrange a D.C. circuit with resistors utilizing longer conductors than is usual with resistors placed around the room. Measure the potential drop across the resistors and compare with the potential supplied by the source.

Remind students that alternating current electricity (frequently not developed in elementary physics) allows for the utilization of transformers and reducing losses by sending electrical energy through wires at high voltages. Yet D.C. losses can illustrate a significant problem that parallels to some degree the problems of sending energy.

- What are the advantages of placing electrical energy generating stations in remote places? (Consider water, oil, gas, and coal-fired steam, and nuclear types of generation.)

- What are the advantages of placing electrical energy generating stations near the consumer?

- What have been the results of recent debates over placement of pump-storage facilities and nuclear powered generating facilities?

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.])

(*Syllabus Reference:* Physics; *Topic II, Electric Current,* G. Conservation of Charge and Energy in Electric Circuits, p. 35)

Activity 8 - Have students calculate the amount of energy wasted if half the households in their community boiled an unneeded kilogram of water per day. Extropolate the figure to a Statewide and nationwide figures. Convert the calories to kilowatt-hours and use prevailing rates to determine the costs to the consumer.

- How many barrels of oil are wasted on an annual basis by the means cited above?

- What are the personal steps to be taken to eliminate such waste?

- What engineering should minimize this type of waste?

(*Environmental Understandings:* [Choices between essential needs and nonessential desires are often in conflict.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.])

(*Syllabus Reference:* Physics; *Topic VI, Internal Energy and Heat,* D. Exchange of Internal Energy, p. 12)

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SOCIAL STUDIES

Grade 7

Activity 1 - New York State in the past 50 years has undergone dramatic changes: changes in the landscape, in economic life, in social structure, and in the respective roles of government at all levels. Many of the results have contributed to the problems we now face in terms of energy and resource scarcity. Development away from the cities has increased reliance upon the automobile, a major user of fossil fuel resources. Industrial and residential construction has infringed upon available farmland and valued natural (plant and animal) communities. Population growth, resulting in ever-increasing rates of resource consumption requires ever-greater per capita costs for goods as resources dwindle.

Have selected members of the class assume the roles of the various people below who, because of their positions or interests, are affected by increasing costs (brought on in part by scarcer resources). These roles and the way such individuals are affected by scarcity and our resources crisis can be explored by the basic question assigned to each role below.

- Low income worker - Why am I affected first and most seriously by the higher cost of energy?
- Middle income renter - Why must rents continually be on the rise?
- Builder - Why am I making my product less saleable by raising purchase prices?
- Urban planner and/or urban businessman - How can I use the fact of an energy crisis as a lever in promoting the rebirth of downtown business areas?
- Suburban planner - What new factors must I consider in completing the development of my suburb?
- Middle income consumer - Which products and services will become increasingly difficult to purchase?
- Middle income consumer - Why are rents no longer 25 percent and food costs no longer 18 percent of my budget?
- Producer/manufacturer/distributor - How can I remain competitive with my products as my costs increase? Will I have to curtail or eliminate the manufacture of some products?
- Landowner/real estate speculator/farmer - Why will my landholdings increase in value?
- Politician - How do we explain or justify to the voters the rising costs of government? Is our tenure in office threatened when we raise taxes to meet these costs?

- Farmer - How much longer can I expect a reasonable profit from my labor in agriculture?

(*Environmental Understandings:* [Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources.] [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits.])

(*Syllabus References:* Social Studies, Grade 7: Our Cultural Heritage; *Topic 7, New York in a Megalopolis Society*, pp. 46-53)

Activity 2 - As a means of examining the functions and responsibilities of State government, select a pupil in the class to run for a key position in State government. The class as a whole would then become the candidate's campaign committee. In addition to other campaign strategies and considerations, introduce the fact that the State's population is highly sensitive to actions which have a negative environmental impact. The people would resent any activities of public figures which exemplified waste and disregard for environmental improvement. With this in their minds, and the questions and suggestions below before them, the committee and the candidate should prepare the campaign.

- Prepare a speech outline for the candidate dealing with resource use in relation to environmental protection.

- Why would five-10 car caravans with bellowing sound trucks traveling from town to town be inadvisable?

- Why would the use of chartered planes for campaign stops be taboo?

- How would public transportation like railroads and commercial planes be used effectively?

- Why would the obvious overuse of gasoline by a fleet of campaign vehicles be detrimental to the candidate's campaign effort?

- Would chartered buses be a way to improve campaign efficiency? Explain.

- What would be the advantage of substituting shopping centers for downtown areas for campaign appearances?

- Would campaigning now consist of concentrated efforts in the most densely populated areas and rely more heavily on the media for outlying areas? Explain why.

- How can we minimize the litter created through the distribution of campaign literature, posters, and the like?

- Should TV, as the most expensive communications medium, be available to all legitimate candidates equally or only to the extent that their solicitations for contributions have provided them with the means to buy time?

- What would be the disadvantages in this type of campaign?

- Are they offset by the advantages, environmentally speaking?

In addition to the alterations in campaign format suggested by the directions above, encourage the students to develop a new, exciting campaign technique such as a telephone solicitation which has a "chain-letter" effect, or making the school-age children of voters aware of the relationship of their classroom environmental studies to political issues. The idea is to publicize and sponsor issues and positions on these issues with a minimum expenditure of resources.

(*Environmental Understandings:* [Choices between essential needs and nonessential desires are often in conflict.] [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.])

(*Syllabus References:* Social Studies, Grade 7: Our Cultural Heritage; *Topic 8, Local and State Government and Civic Responsibility,* pp. 54-65)

Activity 3 - While studying New York in the Age of Homespun with the class, emphasize the trait of self-sufficiency which was characteristic of the era. Have a group of students prepare a presentation of the textiles which were used in the household at this time. The report should include descriptions of the wearing apparel and other textile goods needed by the family. These descriptions should be in the form of drawings, pictures, and facsimiles where practical.

- How were these goods produced by the family, and from what raw materials did they originate? (Is there someone in the community who is a weaver?)

- What were the limitations in terms of design, color, variety, and quantity of these goods as imposed by the existing "technology," time available to members of the household, and the raw materials known or available then?

- Were these textiles produced in this manner for reasons of choice or necessity? Explain.

Have the class compare these 19th century products with those which are used for the same purpose in the 1970's.

- How have the raw materials, the manufacturing processes, and the products themselves changed in the intervening years?

- What are the limitations to quality, quantity, design, color, and raw materials which apply to textiles today?

- Do you anticipate any serious limitations on raw materials for the textile industry in the future? Explain.

- What specific, potential problem for textiles does an energy shortage suggest?

- Is there any way that the textile industry can shift its dependence from nonrenewable resources to renewable resources as a means of avoiding this problem?

- How will the demands of growing population work against such a shift?

- Will recycling provide any relief from this apparent dilemma? Explain.

- Describe some ways in which people today might exhibit greater self-sufficiency for the purpose of abating our ever-increasing demands upon the environment and its resources.

Plan to invite a representative of the textile industry to speak to your class. By way of preparing the students for the arrival of this resource person, have them consider, answer, or investigate some of the questions which follow.

- The increasing use of synthetic fibers in clothing and the relationship of synthetics to petrochemicals suggests that major changes in the clothing industry may be inevitable. Discuss or explain.

- Can we expect substantial increases in the price of synthetic materials? Why or why not?

- Will we be able to get along without polyester even though we now take it for granted, if not rely upon it? Explain.

- If changes such as those mentioned in the preceding questions might reasonably occur, how will employment in the textile industry be affected?

(*Environmental Understandings:* [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.] [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.] [The material welfare and aspirations of a culture largely determine the use and management of natural resources.])

(*Syllabus References:* Social Studies, Grade 7: Our Cultural Heritage; *Topic 5, New York in the Age of Homespun,* pp. 27-39; Teaching The Age of Homespun, *Part 2 - Community Depth Study,* Household Production in the 1820's, p. 54)

Grade 8

Activity 1 - The period following the Civil War in United States history was the beginning of a second age of invention which followed by 100 years the beginning of the industrial revolution. Now, another 100 years later, we may be on the threshhold of a third age of invention. This time, necessity may be even more legitimately called its mother inasmuch as current "shortfalls" of fossil fuels, for example, make it imperative for us to seek alternative sources of energy.

Divide the class into three groups. The first should briefly list the "technological" advances of the late 18th century and early 19th century alongside the need that prompted each invention. (e.g. steam engine - need for more efficient energy as conventional fuel supplies [timber] dwindled) and the benefits to industry, commerce, and progress which resulted. The second group would provide the same information about the innovations which spurred industrial expansion (e.g. open-hearth furnace - increased steel production; the corporation and its ability to raise funds - business and industrial expansion) after 1865. The third group should list the needs we have today (the right-hand column) and speculate as to what inventions or new technologies will be required to meet them (e.g. increasingly limited oil for automobile use - practice turbine engines).

- How has man's ingenuity overcome seemingly insurmountable technological obstacles in the past?
- Is he likely to repeat himself in this respect in the 1970's?
- In what ways can we "hedge our bets," or minimize the absolute necessity of such breakthroughs by adopting a modified lifestyle or new sets of priorities?

(*Environmental Understandings:* [Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources.] [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.] [Resource depletion can be slowed by the development of substitutes for existing (nonrenewable) resources, prevalent lifestyles, and current priorities.])

(*Syllabus References:* Social Studies, Grade 8: United States History; *Topic 2, The National Republican Period* [1800-1825], pp. 77-78; *Topic 5, Economic Expansion* [1865-1902], pp. 101-110)

SOCIAL STUDIES

Activity 2 - The United States emerged at the beginning of the 20th century as a major world power largely due to: the seemingly limitless resources available to a highly motivated people; a successful free enterprise market economy; and the benefits of an egalitarian form of government.

Have a small panel of students assume the role of capitalists or producers operating in 1900, and, using research information, justify their use of the resources available to them. A second small panel of students should assume the roles of producers today who must justify their use of resources in terms of the increased competition for some and in terms of the hazards involved in waste, overuse, and environmental degredation.

- Were the turn-of-the-century capitalists good planners or poor planners? Explain.
- What responsibility did they have to future generations of producers and consumers? How seriously did they take this responsibility?
- Were monopolies efficient forms of business organization? Explain.
- Who benefited from this efficiency?
- What motivated many "captains of industry" (e.g., Carnegie, Rockefeller) to become philanthropists?
- Are there any industries which are controlled by one corporation from the raw materials stage to the retail outlets?
- What happens to product cost when companies are required to incorporate environmental safeguards into production? Why does this happen?
- Are these increased costs worth paying from the consumer's (and society's) point of view? Explain.

Have the class at large summarize the dramatic increase in the number of "ground rules" pertaining to resource use and production from 1900 to the 1970's (e.g., strip mining laws, pollution control ordinances).

- Is there any strip mining or pollution abatement legislation presently before Congress?

(*Environmental Understandings:* [The waste of natural resources can limit the options available to future generations.] [The material welfare and aspirations of a culture largely determine the use and management of natural resources.] [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [Choices between essential needs and nonessential desires are often in conflict.])

(*Syllabus References:* Social Studies, Grade 8: United States History; *Topic 6, The United States A World Power* [1900-1940] p. 111)

Activity 3 - There is much discussion these days about the comforts and conveniences that Americans have come to enjoy and take for granted. Many hold that these comforts are the rightful benefits of an inventive, industrious people, while others suggest returning to a way of life in which self-sacrifice means self-renewal. These positions probably represent the two extremes, but an inescapable fact is that our American way of life requires that we use a disproportionate share of the world's resources.

Have the class consider the origins or the seeds of the lifestyle we enjoy. Refer specifically to the (syllabus) understanding: *In The 1825-1850 Era, Many Of The Comforts and Conveniences Americans Were Soon To Enjoy Had Their Beginnings,** and the major ideas which accompany it. A small group of students might undertake a research project: tabulate 10 to 20 major inventions or developments which spurred progress, made life easier and more interesting, or "improved the human condition," for each of the three periods: 1825-1875; 1875-1925; and 1925-1975. The group should then present its research to the class for discussion, along with illustrations and pictures to dramatize the reporting. (The scope of this activity is such that it might be considered for use as a recurring theme in the year-long course of study.)

- Did there seem to be a noticeable increase in the numbers of significant inventions (available to choose from for your lists of 10 to 20) at any time, or throughout the three time periods? If so, can you offer any explanation?

- At any time, did you notice that research led you to lists of inventions which seemed to include many frivolous or unnecessary gadgets and inventions? If so, give examples and specify the time period(s).

- Would the removal of any of these major inventions from the list have altered the course of human events? Explain.

- For the third era (1925-1975), did you find any items which the world could have as easily done without? If so, what are they and why would we be as well or better off without them?

- Can you establish specific relationships between any of these inventions and such things as energy shortages, resource depletion, and environmental degradation? Elaborate.

- Many parts of the world have obviously not benefited from the inventiveness and creativity you have recorded. Can you explain this? Can you justify this?

- If the world were to derive these benefits to the extent that Americans have, can you speculate on the environmental effects of such universal rogress?

- Make two tables for the period 1975-2050. On one, list the descriptions of five to 10 inventions or developments you feel are likely to emerge. On the other, list those which you think are necessary or urgent and ought to appear.

(*Environmental Understandings:* [Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

(*Syllabus References:* Social Studies, Grade 8: United States History; *Topic 3, The Age of Jackson* [1825-1840's], pp. 83-100.* See especially the second understanding on page 88.)

Activity 4 - Refer to Science, Grade 7-9, Activity 3, on page 40.

(*Syllabus References:* Social Studies, Grade 8: United States History; *Topic 8, The Federal Government and Civic Responsibility,* pp. 127-132. See especially the final understanding beginning on page 131.)

Activity 5 - Refer to Science, Grades 7-9, Activity 4, on page 41.

(*Syllabus References:* Social Studies, Grade 8: United States History; *Topic 8, The Federal Government and Civic Responsibility,* pp. 127-132. See especially the final understanding beginning on page 131.)

Grade 9

Activity 1 - Consider the development of Arab culture (pre-Islam) and the subsequent Islamic way of life. Have the class develop a list of the dominant characteristics of this way of life and match these characteristics with features of the physical environment which caused, shaped, or influenced them. Then, as a third element in this equation of living, have the students describe the influence Western technological progress has had, or is having, on the Islamic culture, especially in the Middle East.

- What patterns of living (in the Middle East) are largely determined by the physical environment?

- How does the physical environment relate to man's constant striving to satisfy his basic needs? Give several specific examples.

- Can the success or advances of Western civilizations be interpreted as a comparative degree of "mastery" of the physical environment when contrasted with the less advanced lifestyle of the Islamic culture? If so, should it be so interpreted? Explain.

- What is the difference between standard of living and quality of life?

- Do the people of the Islamic culture area judge the quality of their lives by the same standards as the people of Western nations? Should they?

- Does the use of the phrase "developing nations" imply that there is one goal or one standard? If so, what is it? If not, should there be one goal for all the world's peoples?

- How has the importance of Middle Eastern oil (which has been made a vital and practical resource by Western technology) influenced the patterns of living in that part of the world?

- What will happen in the Middle East if the Western nations succeed in reducing or eliminating their reliance on petroleum?

- Which one of the Arab nations is it that has the highest per capita income of all the world's countries? Why is this so? Explain why this fact is so misleading.

- How will increasing Western demand for petroleum widen the gap between the rich and the poor of these Arab nations?

(*Environmental Understandings:* [The rate of resource consumption increases in direct proportion to the expansion of our wants, needs, and markets.] [Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.] [Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency.])

(*Syllabus References:* Social Studies, Grade 9: Asian and African Culture Studies; *Topic 1, World Culture Today*, pp. 4-13)

Activity 2 - Refer to Grade 12, (Advanced Economics), Activity 3, on page 83.

(*Syllabus References:* Social Studies, Grade 9: Asian and African Culture Studies; *Topic 7, Southeast Asia.* See especially the understanding on page 72.)

SOCIAL STUDIES

Grade 10

Activity 1 - Select several students to undertake independent study projects which investigate the decline of ancient civilizations. For the purpose of this activity, special emphasis should be placed on the significance of any form of natural resource depletion or environmental deterioration which was a contributing economic factor to the civilizations decline. For example, there is evidence that Babylon suffered from the silting of the Tigris-Euphrates river system; that the Greek civilization severely disrupted the natural environment through the destruction of its forests; and that Phoenicia cleared its forests and, in so doing, saw agriculture undermined by soil erosion.

- Speculate as to whether savants of the time were aware of the potential problems that were being created by such actions, and whether willful disregard was the reason such actions were largely unchecked.

- Given any one of the illustrative studies by the students, did it seem that there were alternatives to these environmental malpractices?

- What reasons could possibly have been given for not selecting the alternatives?

- Describe some similar resources or environmental problems with which we are confronted today, and provide an example of an alternative or a solution that has been proposed for each.

- Although these examples of alternatives might sound logical to you, there are those who have what they believe are good reasons for not accepting the alternatives. List the alternatives and objections to them for each of the problems below, and add categories or individual problems which occur to you.

  -energy shortages (involving each type of fuel commonly used)
  -air pollution
  -1.5 to 3.5 percent annual rate of world population growth
  -inequities in living standards around the world

(*Environmental Understandings:* [The waste of natural resources can limit the options available to future generations.] [Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.])

(*Syllabus References:* Social Studies, Grade 10: European Culture Studies; *Topic II, The Ancient Western World,* pp. 10-13)

Activity 2 - After developing the theme of scientific thought throughout history (Greece, the Renaissance, and the Age of Enlightenment

as influencing the pure and applied scientific thought of the 19th century and 20th century), discuss with students the promise and the threat this achievement represents in terms of the human condition and man's survival.

- How has man's genius threatened his existence at the same time as his standard of living has been improved?
- What are the scientific (technological) achievements which give us our greatest cause for optimism?
- Which scientific achievements ultimately threaten man's existence? Explain how these same achievements can be turned to a more beneficent purpose.
- When technological achievement yields increased comfort, speed, efficiency, and convenience, what price is usually paid in terms of resource depletion and environmental education? Give specific examples.
- How can people be convinced of this frequent imbalance between immediate gains and ultimate consequences?
- Should there be a greater lag time between scientific achievement and commercial application of the principle (thus avoiding the repeated supercession of one minor advance by another which spawns "planned obsolescence")? Explain.

Using a list such as the one provided below, have the class rank the items in the order of their importance as areas which are most in need of scientific research and development. (Students should be prepared to defend their rankings.)

-nuclear energy
-birth control
-home heating systems
-highway construction
-mass transit
-medicine
-space travel
-mining
-cinematography
-agriculture
-food packaging
-internal combustion engines
-sewage treatment
-electrical appliances
-solar energy

(*Environmental Understandings:* [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.] [Social, economic, and technological changes affect the interrelationships, quality, availability, and use of natural resources.] [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.])

(*Syllabus References:* Social Studies, Grade 10: European Culture Studies; *Topic V, Modern Movements of Intellectual Change,* pp. 23-25)

Activity 3 - European nationalism in the late 19th century gave rise to a "new imperialism," as nations vied for economic supremacy. Have members of the class select individual European nations and report on: the reasons for each nation's imperialistic ventures; the specific actions which typified these ventures; the extent of its empire by 1914; and the relationship of these activities to the causes of World War I. (The emphasis on economic factors in the questions below is not intended to exclude other motives for imperialism.)

- To what extent, and in what instances, were these imperialistic ventures largely a matter of economic aggrandizement?
- What resources (name them) were these nations (match them) seeking during their years of empire-building? Why were the resources deemed so necessary?
- Select one nation (e.g., Great Britain) and describe how its 20th century history might have been different had it not gained access through empire to resources around the world. Be specific in naming resources as they relate to the nation's growth.
- Did the fact that these areas of the world were "unorganized" and/or undeveloped in any way justify the colonizing or "imperializing" activities of the Western European nations? Explain.
- Can you think of any modern-day parallels in which force is used to achieve economic objectives? If so, describe them.
- Do the industrialized nations' current concerns about the limits and location of natural resources suggest that economic imperialism is still with us or that developing nations must be especially careful to safeguard their own interests?
- Was the oil embargo recently imposed on the developed nations such a safeguarding of interests, or was it an unjustifiable form of economic blackmail? Defend your answer.
- Can the fact of the location of many critical natural resources in developing nations be interpreted as an "ace in the hole" which will guarantee that these nations will eventually attain Western living standards? Explain.

(*Environmental Understandings:* [The material welfare and aspirations of a culture largely determine the use and management of natural resources.] [As natural resources become scarcer, the inexhaustible supply of human energy, resolve, determination, and ingenuity must be fully utilized.] [Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency.])

(*Syllabus References:* Social Studies, Grade 10: European Culture Studies; *Topic VI, Modern Movements of Political Change,* Understandings 10 & 11, pp. 31-32)

Grade 11

Activity 1 - The proliferation and growth of Federal agencies in the executive branch of our government is a 20th century phenomenon, unparalleled in the nation's history. In selecting several of these independent agencies, such as the ICC, CAB, SEC, etc.,by way of assessing their impact on American society, politics, and economics, include the relatively new Environmental Protection Agency in the class reports or discussion. For example, have students prepare a report on the activities, actions, and mandates of the Environmental Protection Agency, considering the following:

- When the nation recently experienced an energy crisis, a new Federal Energy Office was created. Was this consistent with the practice of establishing independent agencies or did this represent an "executive action?" Explain.
- Develop a case for whether or not such agencies and offices can resolve such pressing issues as environmental protection, resource use, and energy conservation.
- Use the recent examples of energy legislation in Congress to describe the kind of cooperation among the branches of government that is necessary to resolve the nation's problems.
- Cite examples of how pressure groups, private interests, and various lobbyists seemingly are able to thwart policies and legislation which might promote the nation's general welfare.
- Compile a list of groups and organizations which seem to "work the other side of the street."
- Is there room in our form of government for what might be called "citizen's lobbies?" Explain. Can you name a recent example of such a group?

The students should then apply what they have learned in answering the following questions:

- How (by what authority) are such agencies established?
- Do their functions parallel or overlap those of the cabinet departments? Explain.
- How "independent" are these agencies? What is their relationship to the President and the Executive Office and to Congress?
- Predict the future of such agencies given the constant reshaping of Federal-state governmental relationships.
- Does the fact that state governments have similar agencies result in any conflict of responsiblities between the Federal government

and state governments? If so, where and how do these conflicts arise? How are they resolved?

- Summarize with specific press references both the optimism and the pessimism expressed in terms of coping with our energy and resources situation.

(*Environmental Understandings:* [In a democracy, people must consent to, or insist upon, restrictions on resource allocation and use.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

(*Syllabus References:* Social Studies, Grade 11: American History; *Topic II, Government and Politics,* Understandings 2, 3, 4, 7, & 10, pp. 12-15)

Activity 2 - The United States presently finds itself in an energy and resources bind. Oil production and imports have risen somewhat, temporarily alleviating the crisis, but energy resources and other nonrenewable natural resources will become scarcer in years to come. There is considerable debate as to whether such a situation might have been better anticipated than it was. Have each student make one selection from the following list of developments which occurred over the past quarter of a century, but which have only recently gained the attention they merited. In reporting their findings class members should speculate as to what factors caused these developments to go unheeded.

1952 - President's Materials Policy Commission (Paley Report)
... warned of the exponential increase in energy resource use

1954 - Bureau of Mines decision to curtail research into coal conversion (to oil and natural gas)
... the premise that Germany had such technology, and other factors inveighed against this and other types of energy research

1954 - Phillips Petroleum Ruling of the Supreme Court
... giving the Federal Power Commission the authority to regulate natural gas prices kept prices low, thus discouraging exploration for, and development of, new supplies

1963 - Decision to build more than 40,000 miles of interstate highways
... the effects of this decision upon resource use (automobile production) and energy use (gasoline consumption) are almost incalculable.

1966 - Annual Report of the Atlantic Richfield Company
... outlined the prospects for a domestic energy gap

1970 - information that United States oil production was peaking
... coupled with continued increases in consumption and the problems of relying heavily on imports, a crisis became inevitable

Continue discussion of these problems beyond the student presentations through questions such as those below.

- What will be the effect of the Clean Air Act requirement that utilities convert from the use of coal to oil for generating energy?
- What has been the history of the Alaskan pipeline controversy and what will be the impact on the fuel supply problem of this source of petroleum?
- What are environmental impact statements? Give examples.
- Do they contribute to the bases for sound policy and decision making? Why?
- What changes in legislation, executive policy, and public attitudes will be necessary to make these impact statements more effective instruments of environmental protection?

(*Environmental Understandings:* [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.] [As population expands and becomes more mobile, man's demands for natural resources increase.] [Individuals should become well informed about the best ways to manage and conserve our energy supplies.])

(*Syllabus References:* Social Studies Grade 11: American History: *Topic III, American Economic Life,* Understandings 1, 2, & 3, pp. 19-21)

Activity 3 - Select a committee of students and assign the group the task of polling the class on the mobility of their families during the past two generations. Key questions to be used in the survey might be:

- What percentage of the students entered kindergarten in this school district?
- What percentage of the students entered this high school together?
- How many of the students' families have resided in the same city (or village, or town, or country, or state) since the birth of the student's parents? Grandparents?

National statistics can be obtained from Census Bureau and Commerce Department reports, indicating how often families move, among other things. Compare these statistics with the students' findings.

Develop the theme of social mobility with the class. Have students graph the movement of people from rural areas to the cities, 1850-1950, and the shift from cities to suburbs since World War II.

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- What were the major factors which caused the shift in population from farms to cities?
- Why have people begun to abandon metropolitan areas?
- Is this a trend which is likely to continue? What factors could reverse it? What factors should?
- What has been the impact on resource use of this mobility; particularly the fact of growing suburbs which sprawl for miles beyond the cities (in terms of gasoline consumption, highway and housing construction)?
- Describe any other environmental and social impact caused by population growth and mobility.
- Have students trace the history of the Interstate Highway System and Trust since 1952. Obtain maps which illustrate the development of this highway network.
- Who benefits (special interest groups, entrepreneurs, etc.) from the circumstance of a highly mobile population?
- What resources were required to build the system?
- On the other hand, how does the road network help utilize some resources more efficiently?
- Speculate as to what our total transportation system would be like today if the funding for the Interstate had gone instead into a national mass transit system.
- What values are involved in choosing between highways (unlimited personal use of autos) and mass transit?
- What can we learn from the attitudes and practices of Europeans with respect to mass transportation?
- What are some geographic, economic, and social factors which must be overcome before we can expect to rival European success with mass transit?

It should be noted here that the New York State Thruway celebrated its 20th anniversary this year. As a separate activity, have students prepare a summary of its advantages and disadvantages to the people of the State (and the nation, where applicable).

(*Environmental Understandings:* [As population expands and becomes more mobile, man's demands for natural resources increase.] [Natural resources are interdependent and the use or misuse of one will affect others.] [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies. [Man must acknowledge that the interdependence of all

living things dictates the manner in which and the extent to which resources may be used.])

(*Syllabus References:* Social Studies, Grade 11: American History; *Topic I, The American People*, Understanding 11, p. 8)

Activity 4 - Refer to Grade 12, (Advanced Economics), Activity 1, below.

(*Syllabus References:* Social Studies, Grade 11: American History; *Topic III, American Economic Life*, pp. 19-24)

Activity 5 - Refer to Grade 12, (Advanced Economics), Activity 2, on page 82.

(*Syllabus References:* Social Studies, Grade 11: American History; *Topic III, American Economic Life*, pp. 19-24)

Activity 6 - Refer to Grade 12, (Advanced Economics), Activity 3, on page 83.

(*Syllabus References:* Social Studies, Grade 11: American History; *Topic III, American Economic Life*, pp. 19-24)

Grade 12 (Advanced Economics)

Activity 1 - The ways in which government intervenes in the economic system are multifarious as even the most casual observer is made well aware by the passing of a day's events or the perusal of a newspaper. The necessity or practicality of such intervention varies greatly, but can be better analysed and understood if specific types of manipulation or regulation are examined. For example, in a competitive, free enterprise system, conflict between private and public interests is common and such conflict is nowhere better illustrated than in the case of natural resources.

Divide the class into four groups, assigning one of the tasks below to each group.

- Compile a list of nonrenewable resources and a list of renewable resources, giving an example of a common consumer product or service which is derived directly or indirectly from each.
- Sketch an outline of the major events in the history of the conservation of resources in the United States, in its broadest sense, citing people, legislation, etc.
- A third group should select several examples from both lists of the first group and identify the commercial or industrial interests which would be affected by a depletion, or restrictions on the use, of the resource.

Using these selected examples, another group would describe, through comparison:

-the effect, in terms of deprivation or inconvenience or even survival, of product nonavailability versus...
-the environmental impact of continued, unchecked resource exploitation

Use the discussion questions below to bring together for the class as a whole the data produced by the four groups.

- Explain whether or not we are managing our renewable resources wisely.
- Which, if any, of our nonrenewable resources are in danger of imminent depletion?
- How reliable a source are the foreign reserves of these materials? Describe the economic, social, and political factors which influence the degree of reliability.
- Historically, have the efforts to manage and conserve our resources had a significant effect on the status of resource reserves today? Explain. What additional conservation measures might be necessary?
- What major industries would be endangered by rigid pollution controls, restrictions on resource use, and the rank ordering of consumer needs if these policies were instituted by the government?
- What would be the effect on the economy if these industries should decline?
- What kinds of products or conveniences might we do without, short of severely abasing our standard of living?
- How can we modify our lifestyle to the end of reducing our disproportionate (globally speaking) use of resources? Should we?
- What specific environmental problems are created by the normal functioning of our economic system?
- Construct a brief scenario describing a situation in which there is a complete absence of government regulation of resource use or management.
- How necessary is government regulation to the end of insuring the conservation of natural resources? Is there presently enough or too much such regulation? Explain.

(*Environmental Understandings:* [Historically, cultures with high technological development have used disproportionately more natural resources than those with lower levels of technological development.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

(*Syllabus References:* Social Studies, Grade 12: Advanced Economics; *Topic III, The Role of Government*, pp. 19-26. See especially the first understanding on page 20.)

Activity 2 - Economic growth is undeniably a major objective of most countries in the world, including the United States. It can be described in terms of per capita output as a measure of production against population increase and inflation.

Have the class consider the following points and questions while undertaking the necessary reading and research.

- Define GNP.
- Chart the change in GNP over the last decade.
- Determine the percentage of change for each year.
- The figures you found for GNP may have been based upon "current" prices for each of the years used. If so, why is it then important to use figures reflecting "constant" dollars or prices in assessing economic change or growth?
- What has been the average rate of increase in real (using constant prices) gross national product during the decade?
- What is the approximate rate of change in real GNP which is anticipated for the current year.
- What are the advantages of controlling inflation?
- What is the significance of population as a factor in determining gross national product?
- What is the relationship of population size and growth to gross national product?
- What effect will the decline in the rate of population growth in the United States have upon (a) productivity, (b) inflation, and (c) per capita output?
- Is the present rate of population growth (0.62 percent per year as of 1972) in the United States a cause for optimism or pessimism in terms of the economy? In terms of the environment? In terms of social conditions?

- How does this rate of population growth compare with Western Europe's rate? Latin America's? Asia's? Africa's?

- What is the significance of these comparisons in terms of the United States' economic activity in the years ahead?

(*Environmental Understandings:* [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.] [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.])

(*Syllabus References:* Social Studies, Grade 12: Advanced Economics; *Topic I, The Nature of Economic Understanding*, pp. 1-5; *Topic IV, Economic Growth and Stability*, p. 27)

Activity 3 - A basic element of the theory of international trade is the concept of *comparative advantage*. This idea holds that, in the words of the 19th century economist, David Ricardo, "... under a system of perfectly free commerce, each country naturally devotes its capital and labor to such employments as are most beneficial to each..." Simply stated in 20th century terms, comparative advantage refers to the special ability of a country to provide one product or service relatively more cheaply than other products or services.

Have the class develop a list of products and services which are produced for export by several Western nations. For these products selected, have the students determine whether their production conforms to the definition above. Namely, is the country effectively exploiting its labor and capital in the production of these goods to the extent that it has a trade advantage or favorable balance of trade as a result?

Then, instruct the class to select several developing nations and list their exportable products and services. Elicit the same analysis of these products in terms of their economic importance in the international marketplace.

- If a nation's comparative advantage lies with the use of labor and capital in agriculture, mining, forestry, or shipping, should it plan to eventually industrialize its economy? If it did, would there be a period in which it would be at a decided disadvantage in marketing these goods? Explain.

- Is it conceivable that any of today's so-called developing nations will achieve a comparative advantage when its economy has a special ability to provide industrial goods and services? (Remember that this speculation must account for what the economic state of today's industrialized nations will be at that same point in time.)

- Considering the present international marketplace, it would seem to be to the advantage of private industry in the Western trading

nations that the developing and underdeveloped nations maintain a complementary comparative advantage (i.e., other than manufactured goods). Discuss whether or not you agree with this.

- If the above could be considered an accurate appraisal, can that fact be reconciled with the economic and political aspirations of the non-Western, developing nations? Explain.

It has been suggested that, since circumstances in the United States from 1807 to 1812 forced the country to turn from shipping to manufacturing, this less efficient employment of labor and capital eliminated the United States' comparative advantage for nearly a decade. Obviously, the eventual growth of manufacturing in this country soon permitted this advantage to be reestablished with industrial goods.

- How would American economic history have been changed had the United States been more conciliatory in its foreign policy, thus reducing or delaying the development of industry at home?

- Would the inevitable industrial development of America have been merely postponed or severely retarded?

- What similarities and differences are there between this situation and that of developing nations today?

(*Environmental Understandings:* [Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

(*Syllabus References:* Social Studies, Grade 12: Advanced Economics; *Topic V, The United States Economy in the World.* See first understanding on page 33.)

Grade 12 (Advanced Government)

Activity 1 - Given the pressures of population and of resource consumption upon the environment, and the conflicts within society which are generated by these problems, responsible citizenship implies considerable attention to planning. Students should investigate and report on the activities of local government with respect to planning, especially in the following major areas:

-population growth
-housing construction

-zoning for residential, industrial, and commercial purposes
-road building
-schools
-recreational facilities

Once the class has taken the list above (and expanded it) individuals should match these planning responsibilities with the offices, political positions, and/or agencies to which they are, or should be, assigned.

- Discuss whether or not most of the areas of concern are matched by official responsibility for them in your community.
- Do the planning efforts reflect suitably long range thinking about these problems?
- Which of these issues are more appropriately the responsibility of the State or the Federal government? Why?
- To what extent do pressure groups and civic action groups influence the roles of these government officials?
- How are issues, such as the ones listed in the beginning of the activity, identified in a community?

Have each of several committees or study groups select one local government responsibility related to the planning areas mentioned (e.g., issuing building permits) and make a list of the criteria it would establish for decisionmaking. Then, compare these criteria with many of those which actually apply to the position as it is handled by the government official.

To the extent that the Advanced Government syllabus is used as a guide to classroom discussions, have the class choose one of the issues listed above as an alternative model to be used from *Topic II, Identifying The Issue* through *Topic V, Carrying Out The Decision.*

(*Environmental Understandings:* [Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits.] [In a democracy, people must consent to, or insist upon, restrictions on resource allocation and use.] [The limited nature of productive resources makes it imperative that a society define its economic objectives in terms of environmental reality.])

(*Syllabus References:* Social Studies, Grade 12: Advanced Government; *Topic II* through *Topic V*, pp. 8-23)

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SUPPLEMENTARY ACTIVITIES

The activities which follow were selected because of their pertinence to the objectives of this publication. No attempt has been made to refer them to a specific subject area or grade level. These activities should readily supplement environmental education in a variety of classroom situations.

Activity 1 - Obtain a copy of the guide to the video tape series, Man Builds - Man Destroys, from the Bureau of Mass Communications of the New York State Education Department. Of particular interest is the section of this program guide dealing with recycling, "Through the Mill Once More." Duplicate this section, which is on pages 295-303, in order that students may have an opportunity to read and comment, or report, on it.

You may find, upon examination of this video tape guide that the use of many or all of the tapes in this series would be appropriate for students in your senior high school. Information about the acquisition of these taped programs may be obtained from the Bureau mentioned above. Your local public television station will have information about when the programs will be aired on ETV, since the series has been released to the public broadcasting network.

(*Environmental Understandings:* [The nonrenewable resource base of mineral elements is considered finite and depletion can only be slowed by altered priorities, new demographic considerations, improved conservation practices, and vigorous recycling procedures.] [The material welfare and aspirations of a culture largely determine the use and management of natural resources.])

Activity 2 - The series of pictures on the following pages represents silent comment on a number of environmental issues which bedevil us today. The series was presented as part of the June 1973 Statewide Achievement Examination in Social Studies, but it should prove a useful classroom tool for initiating discussion on the topics it represents.

- Each of the pictures represents a different situation, but there are some themes or ideas that tie all the pictures together. Identify and describe several of these themes.
- Discuss one important problem portrayed by each of the pictures.
- What should be the role of the individual and his freedom of choice in each of these problems?

(*Environmental Understandings:* [Earth's resources and recycling system can support only a limited number of people; therefore as populations increase and as resource supplies decrease, the freedom of the individual to use the resources as he wishes diminishes.] [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [As population expands and becomes more mobile, man's demands for natural resources increase.])

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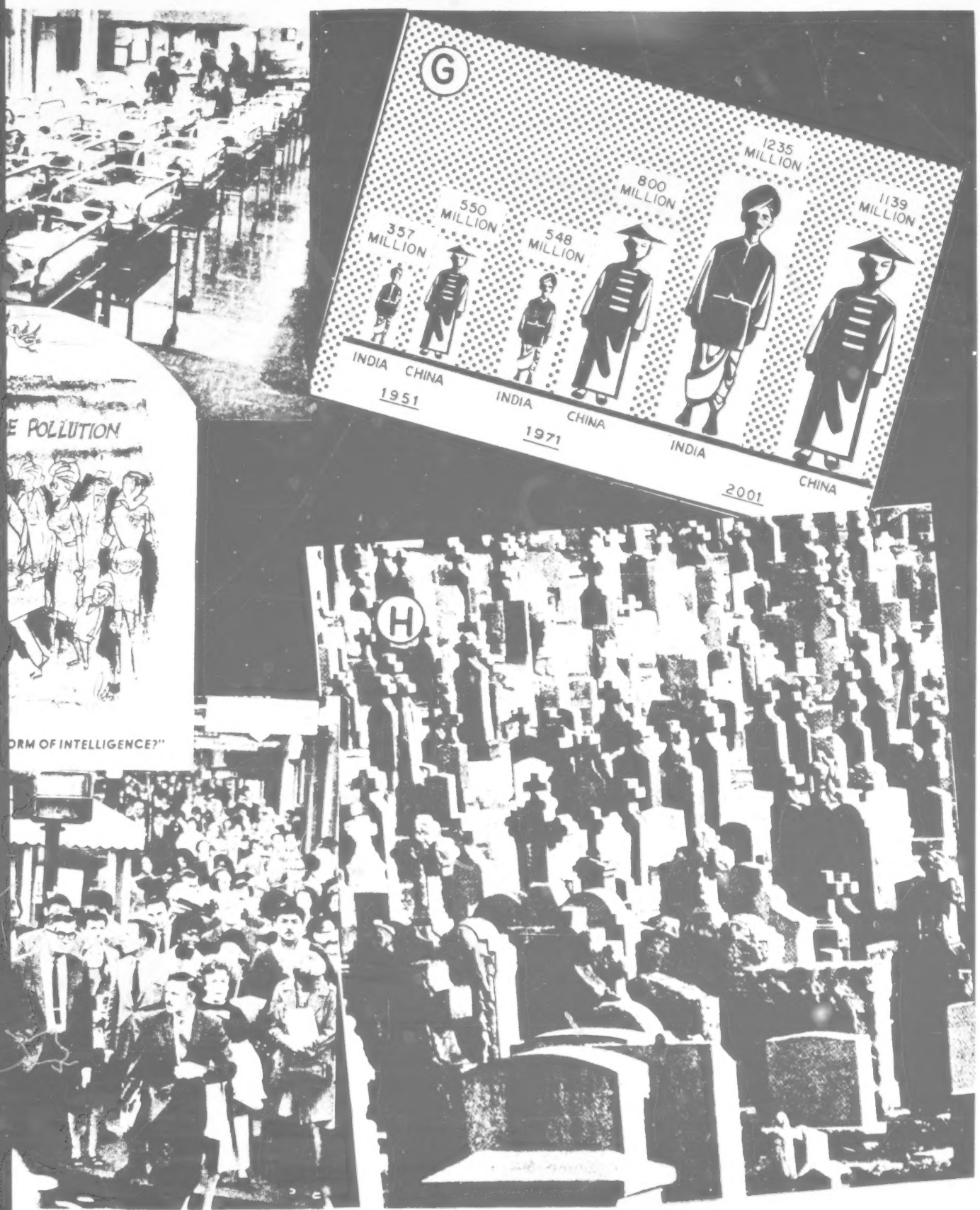

SUPPLEMENTARY ACTIVITIES

*Activity 3 - Suggest that the class members simulate a "public hearing" which has been called to consider the threat to certain vital community services posed by the shortage of gasoline and heating oil. The hearing would provide a forum at which the causes and the specific effects of the crisis and measures to counteract the crisis may be considered. The people asked to participate from within and without the community include: (1) a Congressman, (2) a Senator, (3) a utilities spokesman, (4) an executive vice-president of an oil company, (5) a housewife, (6) a Government economist, (7) an ecologist, and (8) a newspaper editor. A panel of advocates has an opportunity to cross-examine each witness as do people in the audience.

The student participants in this "public hearing" should have an opportunity to read the imaginary but fairly representative comments which follow, since what the public *believes* to be the reasons for an energy shortage is as important a factor as the *actual* reasons for the shortage.

"A high administration official said today that the Arab states' withholding of oil could endanger this Nation's national security by severely limiting our military capability. He went on to say that the oil embargo amounted to blackmail, something that this country just won't stand for."

"A concerned housewife from the Midwest, whose husband has been laid off by an auto manufacturer, blames the Japanese and the Arabs for the current crisis. She says both countries have benefited greatly from trade with the United States, and now they are putting the squeeze on!"

"A noted economist from a major university in the East claims the government has known about a potential crisis for years but has ignored the problem."

" A member of Congress blames the Nixon administration for not coming up with a definitive National Energy Policy which would have averted the current crisis. The Administration blames Congress for not acting on bills that President Nixon sent to Capitol Hill for enactment into law."

"An editorial in a major metropolitan newspaper asserts that major oil companies in the United States, while achieving enormous profits for the last three years, have been in collusion with one another to hold back oil exploration and production. Not only are they not refining oil to capacity, but they are shipping domestic oil to foreign countries who are willing to pay the higher prices."

"A lobbyist for the American Petroleum Industry argues that environmentalists have contributed greatly to the energy crisis by blocking in court necessary programs, such as the Alaskan pipeline, which would free up more energy resources for U.S. consumption. Environmental groups, on the other hand, say dependence on fossil fuels is excessive. What is needed, they say, is research into other forms of energy, such as solar and geothermal, and greater emphasis on recycling."

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*Activities 3 to 9 are based upon materials developed through the combined efforts of the New Jersey State Department of Education, the New Jersey State Council for Environmental Education, and the New Jersey Education Association; namely, Energy Crisis: A Teacher's Resource.

SUPPLEMENTARY ACTIVITIES

(*Environmental Understandings:* [Trade will be mutually beneficial if trading partners specialize in those products in which they have the greatest productive efficiency.] [Natural resource policies come about as the result of interacting social processes: science and technology, government operations, private interests, and public attitudes.])

Activity 4 - Have students review auto advertisements over the past 20 years by looking at old magazines in the library.

- In what ways has the message changed?
- In what ways have automobiles actually changed, in terms of size, price, gasoline consumption, safety, styling, kind of engine, etc.?
- Can you identify other petroleum products used in making a car (not gasoline)?
- What percentage of energy is used in the manufacturing process?
- How often does your family buy a new car?

(*Environmental Understandings:* [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.] [Choices between essential needs and nonessential desires are often in conflict.])

Activity 5 - It has been proposed that we shift our energy dependence from oil to coal. Coal mining requires far more labor than the drilling of oil. Coal mining is a uniquely hazardous and unpleasant occupation. Historically, coal miners have a great impact on society. Have students examine the history of coal miners' labor organizations, and the effect of miner strikes in America and England on the economy and national security of these countries.

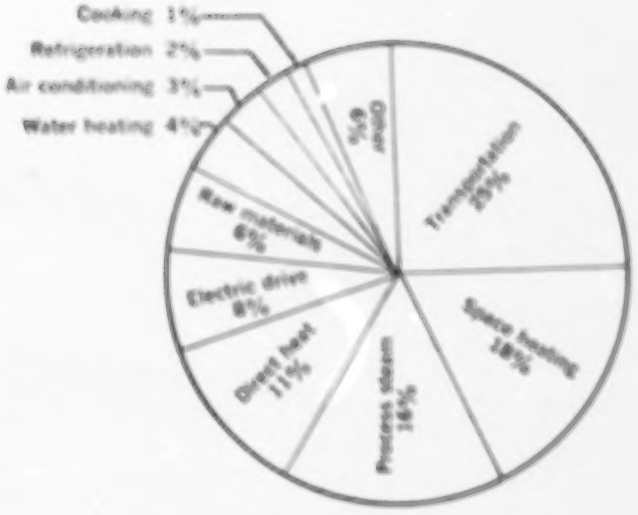
- Assuming a shift from oil to coal, speculate on the effect of a miners' strike on a nation dependent on coal and the labor of a small number of coal miners in addition to both government and labor responsibilities in such a situation.
- Relate this to current claims and speculations that our energy crisis has been caused by the manipulation of petroleum reserves by major oil interests.

(*Environmental Understandings:* [Raw materials and energy supplies are generally obtained from those resources available at least cost, with supply and demand determining their economic value.] [Most resources are vulnerable to depletion in quantity and quality.])

SUPPLEMENTARY ACTIVITIES

Activity 6 - Recent history shows a steady growth in transportation energy use at a rate more than double the population growth rate. Between 1960 and 1970, transportation energy consumption increased by 165 percent as a result of a 124 percent increase in traffic and a 14 percent increase in overall energy intensiveness. The latter increase was due to increases in energy intensiveness for individual modes and the shift from buses and trains to airplanes. For the same time period, energy consumption for urban passenger traffic grew by 165 percent, as traffic increased by 132 percent and energy intensiveness by 14 percent.

The energy intensiveness of a transportation mode—the relative amounts of energy needed to move passengers or freight—is an important consideration in an analysis of the impact of transportation on the energy crisis. Pipelines and waterways are the most energy-efficient modes, followed by railroads and trucks. The airplane is the least efficient mode. Discuss the chart with the class.



- What does this pie chart tell us about the importance of transportation for the energy crisis?

- When President Nixon requested Americans to lower the temperature in their homes and reduce their driving speed, was he attacking the appropriate energy uses? Explain.

- Predict the effects the following would have on transportation and on the energy crisis:

  (1) Increasing the oil depletion allowance
  (2) Increased federal oil leasing
  (3) Limiting oil imports
  (4) Imposing governmental pollution controls
  (5) raising oil prices. (This reduces the demand for oil. Reduced demand is likely to result in a shift toward low energy intensive transportation systems.)

SUPPLEMENTARY ACTIVITIES

(*Environmental Understandings:* [As population expands and becomes more mobile, man's demands for natural resources increase.] [Natural resources are unequally distributed with respect to land areas and political boundaries, thus creating conflicts over priorities in the use, management, and conservation of these resources.])

Activity 7 - Using the chart provided below, students should rate each transportation system on each of the four qualities from one to five. One is for poorest performance and five is for best performance. (For example, "Bicycle" could be given a five for "Environmental Impact" whereas "Car" might receive a one in the same category.) Add the scores horizontally and enter in the "Total" column. The highest total score may be considered the best system.

AMERICAN TRANSPORTATION SYSTEM

	Safety	Energy Efficiency	Speed & Convenience	Environmental Impact	Total
Train					
Motor Cycle					
Two Feet					
Sailboat					
Glider					
Bus					
Airplane					
Canal Barge					
Motor Boat					
Bicycle					
Car					

(*Environmental Understandings:* [The demands of population growth ccupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [Individuals tend to select short term economic gains, often at the expense of greater long term environmental benefits.

Activity 8 - One social characteristic of a major technological breakthrough has been rapid population growth. Obtain census data for population change in the United States between 1900 and 1930 and between 1945 and 1960 to determine percentage increases.

SUPPLEMENTARY ACTIVITIES

- If there were a limitless supply of energy in the future, can you speculate on its effects in terms of population growth?
- Should population be stabilized?
- If so, what are the options for a democratic society?

(*Environmental Understandings:* [The demands of population growth coupled with man's tremendous waste of energy are responsible for some of our more serious environmental problems.] [Man must develop the technical and sociological knowledge needed to control population growth, modify environments, and alter resource use patterns.] [In a democracy, people must consent to, or insist upon, restrictions on resource allocation and use.])

Activity 9 - Given: Presently oil and natural gas account for 80 percent of American energy consumption. Estimates indicate that almost 90 percent of all U.S. fossil fuel reserves are in the form of coal. Have students develop a series of scenarios based on the following: fuel oil for heating and electrical generation has risen in price to 70 cents per gallon; 1975 gasoline prices are 80 cents per gallon for regular and 90 cents per gallon for high test; gasoline rationing allows 15 gallons per family per week.

- What is the general effect of all this on the style of American life and on the American social structure.
- What is the family and personal impact for the student?
- How would a student reconsider and reorder his personal plans and priorities in order to deal with such a future?

(*Environmental Understandings:* [The prevailing condition of scarcity which underlies all economic considerations forces changes in the lifestyles of individuals and societies.] [In a democracy, people must consent to, or insist upon, restrictions on resource allocation and use.])

Appendix

This appendix contains a bibliography of reference books and articles dealing with environmental education with a special emphasis on energy. These annotated references were selected from a bibliography of teacher recources on the energy crisis which was prepared by New York State United Teachers, Inc. NYSUT acknowledged the contribution of the Instruction and Professional Development staff of the National Education Association and special mention was made of the assistance provided by Mrs. Jane Streiff, Librarian, Bethlehem Central High School. Also included are subject headings and a list of general Indexes which will facilitate the use of library resources by teachers and children.

REFERENCE BOOKS AND ARTICLES

American Gas Association. Action in the Atlantic. Arlington, Va.: American Gas Association, 1973. 17 pp.

Brief presentation on offshore sources of petroleum and natural gas in the Atlantic. Excellent charts and graphs. Appropriate for classroom use.

American Gas Association. New Sources of Gas...Where and When? Arlington, Va.: American Gas Association, 1973. 15 pp.

Brief description of causes of shortage of natural gas, as well as discussion of potential new sources, such as offshore drilling, synthetic gases, liquified natural gas, Alaskan and Canadian deposits, coal gasification, and nuclear stimulation.

Caudill, H. M. Night Comes to the Cumberland. Boston: Little, Brown & Co., 1963.

A very readable definitive account of the coal industry.

Citizens' Advisory Committee on Environmental Quality. Citizen Action Guide to Energy Conservation. Washington: Government Printing Office, 1973. 64 pp. $1.75.

Contains a factual account of the energy crisis, including practical tips for energy conservation. Offers suggestions on organizing for energy conservation efforts. List of selected references. Glossary of energy terms.

Council on Environmental Quality. Energy and the Environment-Electric Power. Washington: Government Printing Office, 1973.

A brief consideration of the facts leading to an increased demand for electrical energy.

Do It Yourself Ecology. Washington: Environmental Protection Agency. (1946 Connecticut Avenue, N.W., Washington, D.C. 20036).

Brochure and bi-weekly newsletter carrying regular articles on the energy crisis. (25 cents/copy - $7.50/24 issues).

The Economy of Energy Conservation in Educational Facilities. New York: Educational Facilities Laboratory, 1973.

Practical suggestions for decreasing the use of energy in schools.

The Energy Index: A Select Guide to Energy Information Since 1970. New York: Environment Information Center, Inc., 1973.

Contains abstracts of significant energy documents, lists of books, films, and resources, charts, patents, and official statements. on energy. Suitable for libraries.

The Environment Index '73: A Guide to the Key Literature of the Year. New York: Environment Information Center, Inc., 1973.

Contains resources on the environment published during 1973, including a directory of control officials. Suitable for libraries.

Fabun, Don. Dimensions of Change. Beverly Hills, California: Glencoe Press, 1971.

Chapter 3, "Energy: Transaction in Time," is especially useful.

Frank, Helmut J., and Jean E. Weber. Energy Consumption by States. Tucson: University of Arizona, 1973.

Scholarly monograph that investigates the relationship between energy demand and key economic and demographic factors. Covers the period 1957-1971 and offers projections for 1975 and 1980.

Freeman, S. David. "The Energy Crisis, What Makes It So Complex," Vital Issues, November 1973, p. 6.

The material was prepared primarily for upper elementary students.

Freeman, S. David. "The Energy Joyride is Over," Science and Public Affairs, October 1973, pp. 39-40.

An intelligent prognosis for the current energy shortage. Includes a number of practical and reasonable methods through which energy consumption can be lessened.

Hammond, Allen, et al. Energy and the Future. Washington: American Association for the Advancement of Science, 1973.

Surveys current and future sources of energy from a scientific and technological viewpoint. Authoritative resource.

Hobart, Thomas Y., Jr., "Where We Stand: The Energy Crisis and the Schools." The New York Teacher, December 2, 1973, p. 9.

Hobart, Thomas Y., Jr., "Where We Stand: Children, Conservation, and the Commissioner," The New York Teacher, January 13, 1974, p. 7.

Holdren, John, and Philip Herrera. Energy: A Crisis in Power. San Francisco: Sierra Club, 1971.

An excellent general account of the background and realities of the energy crisis.

Hunter, Robert E. The Energy "Crisis" and U.S. Foreign Policy. New York: Foreign Policy Association, 1973. 79 pp.

Explores current crisis in fossil fuels with specific reference to U.S. foreign relations with the Soviet Union, Israel, and the Arab nations. Excellent list of references.

Knapp, Clifford, and Stuart S. Seim. Bulletin Boards for Environmental Studies. Dansville, N.Y.: The Instructor Publications, Inc., 1973.

Kraft, R. Wayne. "The World's Energy and Teilhard's Vision," America, December 15, 1973, pp. 457-460.

Intriguing and scholarly examination of our present energy predicament and the concept of energy in the context of the universal human dilemma.

Large, David B., ed. Hidden Wastes: Potentials for Energy Conservation. Washington: Conservation Foundation, 1973.

Analyzes methods for reducing energy waste.

Mancke, Richard B. "Blackmail by Oil," The New Republic, October 1973, pp. 8-9.

An analysis of the Arabian oil boycott, including a convincing argument as to why it ultimately cannot succeed.

Meadows, Donella H., et al. The Limits to Growth. New York: Universe Books, 1972.

A highly controversial work covering natural resources and economic growth.

Metzger, H. Peter. The Atomic Establishment. New York: Simon and Schuster, 1972.

Critical analysis of nuclear power business written for the general reader.

Perus, Bruce. "Those Ingenious Exotic Fuels," The Sciences, June 1973, pp. 6-11.

Explores alternative power sources, including solar energy, wind, tides, and gas thermal heat.

Portola Institute. The Last Whole Earth Catalog. New York: Random House, 1971.

Excellent source material on alternative energy sources, including solar power, wind, and water.

Rand, Christopher. "The Arabian Fantasy," Harper's. January 1974, pp. 42-46, 51-54.

A cogent and well-reasoned dissenting view of the oil crisis by a Middle East specialist.

Scientific American, Energy and Power. San Francisco: W. H. Freeman and Co., 1971.

An essay collection on the energy situation. Some are rather scholarly and narrow in scope, but the graphic materials are outstanding.

Winger, John G., et al. Outlook for Energy in the United States to 1985. New York: Chase Manhattan Bank, N.A., 1972. 55pp.

Surveys supply and demand factors in the energy requirements of the United States.

Winger, John G., et al. Outlook for Energy in the United States. New York: Chase Manhattan Bank, N.A., 1970. 60 pp.

Somewhat dated survey of the economics of energy in terms of both supply and demand.

Whittemore, F. Case. "How Much in Reserve?" Environment, September 1973, pp. 16-20, 31-35.

Article discusses strengths and weaknesses of present methods of estimating reserves of coal, uranium, oil, and gas. Generally optimistic about potential reserves.

PERIODICALS

Audubon. 1130 Fifth Avenue, New York, New York 10028.

The Conservationist. New York State Department of Environmental Conservation, Albany, New York 12201.

Environment. Committee for Environmental Information, 438 North Skinner Boulevard, St. Louis, Missouri 63130.

Environmental Education. Dembar Education Research Service, Box 1605, Madison, Wisconsin 53701.

National Geographic Society. 17th and M Streets, N.W., Washington, D.C. 20036.

National Wildlife. National Wilflife Federation, 1412 Sixteenth Street, N.W., Washington, D.C. 20036.

Naturalist. Natural History Society, 315 Medical Arts Building, Minneapolis, Minnesota 55402.

Population Bulletin. Population Reference Bureau, 1755 Massachusetts Avenue, N.W., Washington, D.C. 20036.

Science. American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington, D.C. 20005.

Scientific American. 415 Madison Avenue, New York, New York 10017.

The Sierra Club Bulletin. Sierra Club, 1051 Mills Tower, San Francisco, California 94104.

FILMS

The Ark. 20 min. color. Arthur Barr Productions, P.O. Box 7-C, Pasadena, California 91104.

At Home - 2001. 30 min. color. Modern Talking Picture Service, 315 Springfield Avenue, Summit, New Jersey 07901.

The Challenge of Six Billion. 27½ min. color. Modern Talking Picture Service, 315 Springfield Avenue, Summit, New Jersey 07901.

Illustrates that modern technology has the capability to harness the earth's natural resources, increase food, and find answers to our growing urban-industrial societies.

Cities of the Future. 30 min. color. Modern Talking Picture Service, 315 Springfield Avenue, Summit, New Jersey 07901.

Studies the problems man must face to avoid having the city become a disorganized, unimaginative megalopolis.

Ecological Probe - Planet Earth. 10 min. color. Fordham Publishing Co., 2377 Hoffman Street, Bronx, New York 10458.

The environmental problem in general. An unusual approach.

Ecology - Checks and Balances 14 min. color. Pyramid Films, Box 1048, Santa Monica, California 90406.

Excellent film illustrating predator-prey relationship concept of population control.

Environment. 28½ min. color. B.F.A. Education Media, 2211 Michigan Avenue, Santa Monica, California 90404.

An excellent film illustrating the degradation of our environment.

Later....Perhaps. 26 min. color. The New Jersey State Council For Environmental Education at Montclair State College, Upper Montclair, New Jersey 07043.

Explores the relationship of environmental problems to traditional courses such as history, mathematics, and science through a variety of teaching experiences and situations both in the school and the community.

The Leading Edge. 27 min. color. Modern Talking Picture Service, 315 Springfield Avenue, Summit, New Jersey 07901.

Ways of satisfying man's insatiable need for energy.

Man's Effect on the Environment. 13½ min. color. B.F.A. Educational Media, 2211 Michigan Avenue, Santa Monica, California 90404.

Man has altered the environment through exploitation of natural resources.

Multiply and Subdue the Earth. 67 min. color. Indiana University Audio-Visual Center, Bloomington, Indiana 47401.

Documentary tracing the major environmental problems confronting society.

No Deposit - No Return. 10 min., color. Centron Educational Films, 1621 W. 9th Street, Lawrence, Kansas 66044.

The condition of the land and the people who live on it.

A Search for Ecological Balance. 38 min. color. Film Images, 17 W. 60th Street, New York, New York 10023.

Ecology and environmental education.

The Shadow of Progress. 26 min. color. Modern Talking Picture Service, 315 Springfield Avenue, Summit, New Jersey 07901.

An examination of our technological, affluent age.

This Vital Earth. 10 min. color. New Jersey State Museum, Film Loan Service, Trenton, New Jersey 08625.

Essentials for survival, interdependence of plants and animals, how man has upset the nature balance by depleting soil.

Time To Live. 29 min. color. New Jersey State Museum, Film Loan Service, Trenton, New Jersey 08625.

Human progress dependent on production and utilization of cheap, versatile sources of energy; some sources of energy that meet the criteria.

To Conserve and Protect. 14½ min. color. Time-Life Films, 43 W. 16th Street, New York, New York 10011.

Noise pollution, its causes, effects, and what can be done about it.

Treehouse. 9 min. color. King Screen Productions, 320 Aurora Avenue, North Seattle, Washington 98109.

Interrelationships of man and the natural environment.

MULTIMEDIA MATERIALS

The Ecological Crises. 6 Filmstrips, 3 records, or cassettes, guide. Q-ED Productions, 2921 West Alameda Avenue, Burbank, California 91505.

Overpopulation and pollution and how they threaten man.

Ecology of Polluted Water. 87 slides, cassette, script. Nasco, 901 Jonesville Avenue, Fort Atkinson, Wisconsin 53538.

Causes of water polution, effects on man and his environment, methods available to help clean polluted water.

The Environment - Challenge of the '70's. 6 tapes, guide. Washington Tapes, 5540 Connecticut Avenue, N.W., Washington, D.C. 20015.

Interviews with government officials on environmental problems and solutions.

Environmental Crises: What the Individual Can Do. Filmstrip, record, guide, script. National Education Association, 1201 16th Street., N.W., Washington, D.C. 20036.

Specific alternatives to current lifestyles to reduce air and water pollution. High student involvement.

Man and His Environment. Filmstrip, record, booklets, guide. National Education Association, 1201 16th Street, N.W., Washington, D.C. 20036.

Guide for teachers in developing an interdisciplinary approach to environmental education.

The Planet Management Game. Houghton-Mifflin, 110 Tremont Street, Boston, Massachusetts 02107.

Players act as decisionmakers on an imaginary planet. Students "solve" environmental problems through role playing.

The Pollution Game. Houghton-Mifflin, 110 Tremont Street, Boston, Massachusetts 02107.

Players try to agree on proposals to improve environmental quality; the profit motive vs. human values.

The Seventies: Decade for Decisions. Filmstrip, record, guide. New York Times, Book and Education Division, 229 West 43rd Street, New York, New York 10031.

Explores technological and other changes that will affect the environment in the next decade.

Topics in Ecology: What is Ecology? Filmstrip, record, guide. Multi-Media Productions, 580 College Avenue, Palo Alto, California 94306.

Excellent interdisciplinary, problem-solving approach to environmental education. Makes students aware of problems they may not have previously considered; values clarification.

GENERAL INDEXES

The following general indexes are extremely valuable sources for many types of materials on the environment. Through these indexes, teachers and students will find periodical and newspaper articles, government documents, research reports, curricula, bibliographies, audiovisual materials, sources of free and inexpensive materials, and countless other items of interest. Most of these indexes are readily accessible in school, public, or research libraries.

Applied Science and Technology Index

Education Index
Educational Resources Information Center (ERIC) Research in Education
Educator Guide to Free Films
Educator's Guide to Free Filmstrips
Educator's Guide to Free Health, Physical Education & Recreation Materials
Educator's Guide to Free Science Materials
Educator's Guide to Social Studies Materials
Elementary Teacher's Guide to Free Curriculum Materials
El-Hi Textbooks in Print
Essay and General Literature Index

Facts on File
Free and Inexpensive Learning Materials

Guides to Educational Media

Monthly Catalog and United States Government Publications

New York Times Index
NICEM Index to Ecology (Multimedia)
NICEM Index to Educational Audio Tapes
NICEM Index to 8 mm Motion Picture Cartridges
NICEM Index to Overhead Transparencies
NICEM Index to 16 mm Educational Films
NICEM Index to 35 mm Educational Filmstrips

SUBJECT HEADINGS

Environmental education encompasses many issues, topics, and areas of study. Often a specific issue or topic will focus a teacher's or a student's interest more effectively than a general subject or area of study does. The facsimiles of subject cards which appear on the following pages constitute a list of environmental subject headings which is provided with the hope that those using this guide will not be limited in their search for resources for want of a suitable range of topics. Yet the list, while extensive, can never be complete inasmuch as new relationships between environment and other fields are constantly being realized.

1.

ENVIRONMENTAL EDUCATION
see also

Adaptation (Biology)
Aeroplanes. Noise
Air. Pollution (or Air pollution)
Air purification
Atomic energy
Atomic power
Atomic power industry
Atomic research
Automobile exhaust gas
Automobiles
Automobiles. Engines

2.

Birth control
Cities and towns. Growth
Cities and towns. Planning
City noise
Cleaning compounds
Coal mines and mining
Coal research
Community development
Conservation
Conservation education
Conservation of energy
Conservation of natural resources (or: .... of resources)
Detergent pollution

3.

Diesel engines
Disinfection and disinfectants
Dust
Ecology
Economics
Electric power
Electric utilities
Electric vehicles
Electricity
Energy crisis

Energy crisis and the environmental movement
Energy crisis. U.S. foreign policy
Energy crisis. Sources (of information)

4.

Environment
Environmental .... For example: Environmental health, policy, education, etc.
Factory and trade waste
Forests and forestry
Fuel
Fuel research
Fuel resources
Gas, Industry
Gas, natural
Gas, manufacture and works
Gas supply
Gasoline
Gasoline Industry

5.

Geothermal energy
Human ecology
Hydroelectric plants
Hydrogen
Hydrogen, liquid
Hygiene. Public
Industry and state
Industry and the environmental movement
Insecticides
Insulation
International Atomic Energy Agency
Jet planes. Noise
Man. Influence of environment
Man. Influence on nature

6.

Marine pollution
Marine resources
Mines and mineral resources

Natural resources (with subdivisions)
Nature conservation
Noise (with subdivision - example: Noise. Physiological effect.)

7.

Noise control
Nuclear fuels
Nuclear fusion
Nuclear reactors
Odor control
Oil lands
Oil pollution of rivers, harbors, etc.
Organization of petroleum exporting countries
Pesticides
Pesticides and the environment
Petroleum
Petroleum industry
Petroleum refineries
Petroleum supply

8.

Pollution
Population
Power resources
Radioactive fallout
Radioactive pollution (or contamination) of water; the sea; the atmosphere
Radioactive waste disposal in rivers, lakes, etc.
Radioecology
Reclamation of land
Refuse and refuse disposal
Sanitary engineering
Sanitation
Sewage engineering
Slums

9.

Smog
Smoke
Soil Conservation

Soil erosion
Soil exhaustion
Soil pollution

10.

Solar energy
Solar furnaces
Solar heating
Spraying and dusting residues in agriculture
Strip mining
Thermal pollution of rivers, lakes, etc.
Traffic noise
Waste disposal in the ocean
Water. Pollution (or: Water pollution)
Water. Purification (or: Water purification)
Water conservation
Water quality
Water resources development
Water - supply

11.

Wildlife. Conservation
Wind power

Acknowledgments

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